SURVEY, MAINTENANCE

AND

SETTLEMENT

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Part I.

SURVEY AND MAINTENANCE.

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PREFACE.

In 1918 I was selected by Mr. C. A. Henderson, I.C.S., the then Director of Land Records as the instructor for the Land Records Tahsildars' Survey Training School at Pallavaram. I then compiled two volumes of notes on Survey and maintenance which were made use of for the next two schools. After my deputation to Settlement work I had to conduct training classes for Assistant Collectors in Survey and Settlement every year from 1921 to 1925. I have brought out in print my lectures on these subjects, those on Survey and maintenance being mostly a reproduction of my original notes considerably revised and abridged to meet the requirements of the officers for whom they are intended. The book is not intended for the public but only for the Assistants that may come up for training and for such of the officers in the Revenue and Settlement Departments as may desire to have a general idea of the subjects dealt with. I trust it will be found useful. This book should be read along with the Chain Survey Manual and the Standing Orders of the Board of Revenue.

17th August 1931. A. A. VENKATARAMA AYYAR.

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CHAPTER I—INTRODUCTORY.

The object of all land surveying is the determination of the boundaries and the relative position of the objects on any portion of the earth's surface with a view to the production of a pictorial representation of the tract of country on paper with all its distinguishing features.

Revenue Survey has another object in view and that is the obtaining of the accurate areas of the land surveyed.

A Cadastral Survey is a Revenue Survey on a large scale in which the boundaries, area and ownership of each individual holding or Revenue unit are determined.

For better or worse we are wedded in this Presidency to the ryotwari system the fundamental principle of which is that for a certain period of time a certain assessment is due on a certain land of a certain quality and is recoverable from a certain individual whose name is shown in the accounts. That is, each individual holder of land pays land revenue in proportion to the extent of his holding and to the quality of the soil. We deal directly with each ryot. We have given him the right to extend his holding by taking up more lands on application to Government or to curtail or abandon his holding altogether by relinquishing a part or the whole of it. Land revenue, including miscellaneous revenue, has to be calculated on holdings. There is, therefore, a necessity for a detailed survey. This detailed survey of holdings is known as Cadastral Survey. The object of such a survey is the determination of village and field boundaries, the preparation of a village map showing such boundaries and of area lists and field registers, the former giving the area of each field and the village, and the latter containing particulars as to number, tenure, ownership, etc., of each field.

Such a survey is necessary alike in the interests of Government and of the ryot. The Government wants it primarily in the interests of revenue—to arrive at the exact and correct area on which to calculate the assessment. From time immemorial the 'field' has been the unit of landed estate in the Southern Presidency and the public demand on the ryot is the sum of the assessments on his several fields, the assessment on the field being the money value of the Government share of its produce. To assess a field it is necessary to know either on the one hand the quantity of its produce without reference to its area; or, on the other hand its area and the quantity of the produce of a given part of it or of an equal portion of other fields of similar quality and condition. A settlement based on the former of these methods would be interminable, and necessity compels the adoption of the latter. Of the two branches of enquiry which the method involves the determination of

areas is the province of the Survey Department, of produce alone that of the Settlement Department. That is to say, the Survey Department decides how much land the ryot shall pay for, but the Settlement Department decides at what rate he shall pay. The survey of course does a great deal more than merely give you a record of accurate areas. It gives you detailed maps and in consequence lays down individual boundaries. The ryot that pays us revenue expects in return a record of his holding sufficiently minute to serve as an authoritative safeguard against encroachment by his neighbour. The high commercial value of land in several places of the presidency and the sentimental value attached to the land by the ryot make him tenacious of even the smallest piece of land. The acquisitiveness of many ryots leads to incessant attempts at encroachment, and, even where encroachments are not actually made, there is the vivid fear that it would be made. In such cases it is to the record of measurements that the ryot looks for the protection of his own interests against his greedy neighbour. In the case of Civil disputes the record of measurements profoundly affects the view taken of each case. And as far as the boundaries relating to lands in which Government, as the trustee of the people, are directly interested—the porambokes—are concerned, it is this minute system of survey that has enabled us to protect such lands for the use of the community and to guard against encroachments.

Remember there are always two distinguishable processes going on in a Cadastral Survey—the localisation of a 'boundary' and the measurement and mapping of it. The first is a legal process and the second a technical survey process.

Thus the duty of determining the boundaries and the extent of the holdings is done in the first instance by the Survey Department. The classification of the quality of the soil and the determination of the rate at which the land should be assessed are among the functions of the Settlement Department.

A Cadastral Survey, is therefore a necessary adjunct to a settlement under the ryotwari system. The one is useless without the other. It is impossible to dissociate the two records. You may regard the two sets of records as the Atlas and the Geography. The latter which is the Diglott gives a descriptive account, or, 'specification' of the fields shown in the Atlas. You cannot construct the one from the other though they relate to the same survey field. From the field Measurement Book you cannot say whether a field is Poramboke or not and from the Diglott you cannot know the shape of the field or locate it on the ground. If these two sets of records are discrepant, they cannot serve the purposes for which they are intended.

The most important thing to remember about these records is that they can never be final—particularly a Cadastral Survey recording boundaries about which there can be no finality. All that we can say is that the operations of Survey or Settlement are over and that the records, if they are to be kept up to date, have to be 'maintained'—*i.e.*, preserved, corrected, and altered as the boundaries alter or are found to be wrong and as the 'specification' requires to be altered. Both

Settlement and Survey serve no ends in themselves but merely facilitate the general Revenue administration and the dealings with reference to the land. A survey is only a record of what the surveyor honestly found on the ground at the time the survey was made and the resulting map is a pictorial representation of the land. These facts like everything else in nature are liable to change; and if the record written or mapped is not kept up to date it would soon cease to represent what it once professed to. The boundaries of holdings alter as a result of various administrative orders, mostly as a result of sub-divisions sanctioned. The necessity for the alteration of the record due to subsequent changes is thus obvious. You have also to correct the records in some cases. The necessity for correction arises from the possibility of errors in the original survey and such errors may arise from a variety of causes and manifest themselves in various ways.

They may arise from

(i) inaccuracy of observation

(ii) inaccuracy in the instrument with which the observation was made

(iii) inaccuracy in the plotting of the actual plan due to carelessness or bad draftsmanship

(iv) miscopying of figures :—0, 6 and 9, 3, 5 and 8, 4 and 6, 1 and 7; and a variety of other possibilities of error. Such errors when detected in the records have to be corrected.

The records then have to be in a shape and in a form capable of being corrected, altered, amended or added to by the creation of fresh sub-divisions or the amalgamation of the old.

So far as the record of 'specification' or the Diglott, is concerned, it is prepared afresh at the end of a period of a settlement. During the currency of a settlement changes resulting from administrative orders have to be carried out, such of these changes as affect the mapped record being incorporated also in the latter. We have then the following essential minimum for a record :—

A complete specification, up-to-date registry, and a series of independently plotted field plans to scale. We have also a village map of course, but that is chiefly intended as a key to the fields and there are other subsidiary records which affect the subject. But the essence of our main record consists of the Diglott and the Field Measurement Book.

Reference has been made to 'up-to-date registry' meaning the entry of the name of the registered holder from whom land revenue is due to Government. Revenue registry is almost the most important feature of the maintenance system; for, if you consider the position it is just as logical, if not more so, to start with the name of the landowner, the ryot, and so to go through the scale till you come to the demarcation of the land, as to follow the other order starting with the survey stone. Resettlements nowadays have very little to do with settlement work proper. There is no doubt a revision of the rates and a consideration of the financial and economic position of the tract in question. But certainly the greater portion of a

settlement officer's time is devoted to a consideration of the results of the neglect of maintenance in the past, the bringing up to date of the registry of the land, with the consequent necessary alterations and corrections of the field measurement books. Revenue registry is of course the most important feature of the maintenance system. Then come the records and maps. And lastly, and in their proper place, come the survey marks which assist in the proper carrying out of the changes in the maps and records. A minimum number of fixed points must be 'preserved' to enable the records to be 'maintained', to identify fields with rapidity, to measure new sub-divisions and to detect and prevent encroachments.

To sum up (1) No system of land revenue can exist without some sort of record of the land-holders and of their holdings (2) on our system of ryotwari tenure a very detailed Cadastral Survey is necessary (3) such a survey must be authoritative *i.e.*, legalised because it involves the determination of boundaries which is essentially a legal process (4) The record in any form must contain two parts—a detailed account of the various attributes of all parcels of land—or, specification—and the name of the owner. The field measurement book is a further necessity for the amendment of the survey portion of the record (5) This record can only hold good for the time at which it was prepared. If it is to last any longer, it has to be constantly corrected, altered and amended as transactions occur or as errors are detected. This is technically known as 'maintenance'.

You are trained for the work of 'maintenance' *i.e.*, the preservation, alteration and correction of the records required for every-day Revenue Administration. The up-to-date map and the up-to-date record are what we are aiming to produce. But before you learn to 'maintain' you have to know how the records, particularly the mapped record, have been produced. The first half of the course will therefore, be devoted to showing how the records are produced.

CHAPTER II—DEMARCATION.

The main processes in a Cadastral Survey are demarcation, measurement, mapping and computation of areas. An idea of the whole operation can be gathered from the several processes which are detailed below.

A—Boundary demarcation (Villages and Khandams).
B—Traverse Survey.
C—Traverse computation.
D—Traverse plotting.
E—Field demarcation.
F—Field measurement.
G—Plotting village map.
H—Finishing village map and area computation.

Demarcation.—Before a survey in the sense of actual measurement can commence, the holdings that have to be surveyed have to be marked on the ground and the points between which measurements have to be taken have to be fixed.

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It would be aimless to survey without knowing what it is that has to be surveyed. The fixing of the boundaries, therefore, must always precede measurement.

Meaning.—The demarcation of the boundaries of any land is the fixing on the ground of its exact limits. With what minuteness these limits should be laid will depend on the purpose of the survey. If the object of a survey be only to depict the topographical features of the country the work need not be elaborate. In a Cadastral Survey, on the other hand, affecting Government revenue and the rights of invidual land-holders the limits have to be more precisely laid. In other words, the degree of the intensity of the demarcation is always conditioned by the use to which the survey is to be put. Obviously then, in a minute Cadastral Survey where you lay down boundaries which may be disputed or altered the demarcation must be intensive, in a way not necessary for a topographical survey.

The two processes in demarcation.—It does not, however, follow that the exact contour of the land should be adhered to, nor is this possible or even necessary. Not uncommonly, fields have crooked or zig-zag boundaries. It is impossible to note all the details of slight deflexion from a straight line. Such deflexions are further liable to constant changes from season to season and the chances of a corrugated boundary retaining the same features are much fewer than in the case of a straight boundary. An arbitrary approximation is the only practical method that can be adopted. Minute demarcation at every bend of the field obviously involves greater cost and more time. We have therefore to consider how far we could simplify demarcation consistently with the purpose of the survey and the interests of the ryot as well as of the Government. There are two processes in demarcation the adoption of which improves the method of survey, expedites work, saves time and cost and secures all these without affecting the Government's or the ryot's interests. These are equalisation and ignoring of bends.

If, for instance, there are one or more bends between two occupied lands of the same description, class and sort of soil, (see fig. 1) the bends may be equalised as shown in the diagram. In other words, the surveyed boundary may run straight from one end of the field to the other. A perusal of the way in which the boundary is taken will show that neither party loses, as one party gives up in favour of the other as much as he gets from him. A number of stones at all intermediate bends is avoided—which simplifies and cheapens the work both to the ryot and to the Government.

Also, for the same reasons, *viz.*, to simplify work and to reduce cost, trouble and time, bends are ignored up to a certain limit which has been fixed on a consideration of the valuable nature of the land and the effect which such ignoring will have on the Government's or the ryot's interests. The rule is that bends within 10 links when the land is valuable and 20 in dry lands of little value may be ignored. That such ignoring will not materially alter the map, area or assessment will be clear from the following :—

(1) In a field map a space of 10 or 20 links does not show any difference in the plotting. It is much more so in the village map which is on a smaller scale.

(2) In computing the area we ignore extents below 500 square links or half a cent; and, as the area is taken by the area square or computing scale, and as the bend will not appear in the plotting, the area obtained is bound to be the same whether the bend is retained or ignored.

(3) Even should the area differ slightly it will not affect the final assessment as the settlement assessment on each holding is rounded to an anna.

Exceptions.—The two processes explained above have only a limited application (1) they cannot be applied in the case of porambokes by which expression is meant lands set apart for public or communal purposes. As the *limits* of porambokes are more important than their areas, equalisation or ignoring of bends will prejudicially affect the purpose the poramboke is intended to secure, (2) they should not also be applied in the case of lands of different description and tenure, which affect revenue, (3) nor at places where three or more villages or fields meet, or, at village and field trijunctions, but only between the bends of two fields which are bijunctions, (4) they should not be applied when the lands are of considerable value, nor (5) when there are any trees, wells, or buildings and (6) when the ryots have a reasonable objection to the surveyed boundary being taken otherwise than as it is on the ground.

Legally also, the Survey Act renders it incumbent on a Survey Officer to measure according to the existing boundaries—of course, so far as his unit of measurement, *viz.*, the link, will permit. If the boundaries are altered by either of the two processes mentioned above without the ryot's consent or in his absence, the operation is illegal and therefore not binding. All that can, therefore, be done for effecting the above two processes is by way of persuasion and inducement. Crooked boundaries are uneconomical to the ryot and it is desirable that this should be brought home to him and he induced to straighten his boundaries.

Though the initial demarcation of all ryotwari tracts has been completed and that has to be accepted as final, a knowledge of the general principles governing such demarcation is not only instructive but also necessary for further work.

Village boundary demarcation.—All survey operations having to proceed from whole to part, the boundary of the village is demarcated first. Existing limits of occupation are adhered to and all bends are marked with field stones. Theodolite stations are fixed at all points of junction of three or more villages and at convenient distances on the village boundary, generally at the more important bends. Every boundary station must be on the true village boundary. Each station must be as far as possible from the next one and must be clearly visible from it.

Where a river forms the boundary of a village, Theodolite stations are erected on each bank and the middle of the river bed is considered the true boundary provided existing rights are not interfered with.

When a reserved forest adjoins the village boundary, the boundary should be demarcated excluding the forest except in the case of forests of Class III,

Theodolite stones should be used and these should be fixed close to the cairns or other marks put up by the Forest Department. But the number of such stations should be reduced by cutting, with the consent of the Forest Department, the broad arrow and the plummet hole on the Forest boundary pillars where such exist.

Khandam demarcation.—On the completion of the demarcation of the village boundary, the limits of reserved Forests within the village boundary and of all hills, tanks, village sites and other tracts more than ten acres which are impracticable for chain triangulation should be demarcated. Such of these as are more than 100 acres in extent will be marked as Khandams and the smaller ones as *minor circuits*. The remaining area of the village will then be formed into Khandams of 100 to 200 acres in extent and demarcated.

Khandam boundaries should as far as possible follow existing natural and permanent land marks such as streams, channels, roads, railways, etc. The boundaries should present as few irregularities as possible. The Khandam stations should be from 30 to 40 chains apart and commence and close on village boundary or other Khandam boundary stations. Khandam boundaries should be demarcated in the same manner as village boundaries. Theodolite stones should be used for Khandam stations and field stones for the bends on Khandam boundaries.

Minor circuit boundaries will be marked by field stones. Such of these as are selected for station sites will have a plummet hole drilled on the top.

Demarcation of holdings.—As village and Khandam demarcation is only the skeleton for the detailed Cadastral Survey which is to follow, there has not been any appreciable alteration in the rules governing such demarcation. The object of fixing the village and Khandam boundaries first and surveying them more accurately is to ensure the accuracy of the detailed Cadastral Survey, to restrict and localise errors, to ensure an accurate map and to check the correctness of the area computation. In regard to the demarcation of fields within each Khandam the rules have varied from time to time, the variations being due to considerations of convenience of survey operations, saving of cost, time and labour and facility of maintenance.

Before dealing with the demarcation of fields, it is necessary to know what a "*revenue field*" is. A revenue field is every field registered separately in the revenue accounts. It may be either occupied or unoccupied. If occupied, it is a distinct piece of land of one description of soil and held on one tenure by one man or jointly by more. If unoccupied, it is either poramboke or waste—assessed or unassessed. Occupied revenue fields always form distinct items in a patta.

The object of a Cadastral Survey being the determination of the boundaries, area and ownership of each individual holding, strictly speaking, each separate holding should be separately demarcated, measured and mapped. But it has always been recognised that it is impossible to survey separately the minute subdivisions prevailing in many villages—often less than a quarter or even an eighth

of an acre. For the purpose of survey, therefore, a number of these very small fields should be clubbed so as to form a convenient plot. Different standards were fixed at different periods as regards the limits up to which holdings could be so clubbed, the question coming up for consideration again and again when the slow progress of the Madras Survey Department was attracting attention. Clubbing of holdings or 'Revenue fields' to form what are known as "Survey fields" was allowed in order to avoid excessive demarcation.

The present rules are that holdings should be clubbed up to 5 acres in wet and 10 in dry subject to the condition that no clubbed filed should contain more than 20 sub-divisions and at the same time measure more than 2 acres in wet or 4 in dry. See B. P. No. 255/R. S. dated 19–10–1917.

While holdings are clubbed as above and formed into survey fields, porambokes and other Government lands are also split up into convenient fields except such of them as have to be measured as sub-divisions.

All roads, cart tracks and channels shown as poramboke in the revenue accounts should generally be demarcated as separate survey fields if half a chain or over in width and as sub-divisions when less. Those included in occupied holdings or large waste blocks should not, except in special cases to be determined by the Revenue Officer, be sub-divided but marked as details.

All roads, railway lines and channels 50 links and above in width should be formed into survey fields of more or less a uniform length of 10 chains.

Porambokes in general were not, either in the original surveys or in re-surveys, surveyed as such. As a matter of history the revenue survey having been principally concerned with the determination of accurate areas for purposes of assessment, porambokes have in many cases come to be merely the residuum. All lands situated outside the "ayacut" or limits of occupied lands were constituted as porambokes with the result that most of the fields surveyed as poramboke have irregular boundaries and often include land not required for public or communal purposes. In all future surveys, therefore, the order is that porambokes should be surveyed as such with as straight boundaries as possible. The odd bits of Government land excluded by such straightening should be included in the adjacent holding with the consent of the registered holder provided there is no objection to the free assignment of the plot on darkhast. (See the interesting letter of Mr. Stuart in B. P. 20/R. S. dated 1–2–1917).

Railway lands are divided into four classes A, B, C and D or into Permanent and Temporary according as the Railway Company is entitled to provision of land by the Government free of cost or not. For a description of these lands please see p. 77 of the Chain Survey Manual. The different classes of railway lands are separately demarcated and surveyed.

Big waste blocks which are likely to be taken up for cultivation in future are split up and formed into survey fields of about ten acres each.

The holdings which have been clubbed into a 'Survey field' and such other descriptions of land as have not been formed into new survey fields are treated as sub-divisions of the fields in which they lie. Channels above 20 links but less than 50 in width under the control of the Public Works Department should be measured as sub-divisions of the survey fields in which they lie. All channels and paths not exceeding 20 links were till some time ago shown as details only except in cases where, for special reasons, their sub-division was considered advisable by the Revenue Officer.

Under the latest orders the following procedure should be followed in future resurveys :—

(*a*) Channels and paths which have already been treated as separate sub-divisions and registered as poramboke in Revenue accounts should not be included in holdings even though they may not exceed 20 links in width.

(*b*) Channels and paths included in holdings should not, except in special cases to be determined by the Revenue Officer, be sub-divided but marked as details in the map. G. O. No. 1552 Rev., dated 8–10–1923 and G. O. No. 1488 Rev., dated 23–9–1924.

Demarcation with stones.—As the boundaries of fields and other sub-divisions to be surveyed are determined as above, they are demarcated with stones. Any other mark would serve the purpose of a survey but a stone has been selected on account of its durability and permanency. The rule formerly in force as regards whole fields was that every bend should be demarcated with stone. As regards sub-divisions, the rule varied from time to time. At one time all the sub-division points were ordered to be demarcated with stones ; then, only such of them as had no natural boundaries on the ground, in order to indicate their limits ; later on, the demarcation of sub-divisions was given up wholesale ; finally, and as the rules stand at present, only sub-divisions affecting poramboke boundaries should be demarcated.

Under the present rules, the only points requiring demarcation are Theodolite stones, field trijunctions (places where three or more fields meet) and terminal points of 'G' lines which do not coincide either with Theodolite stones or field trijunctions. In the case of porambokes and village boundaries, and minor circuit fields however, all the bends have to be demarcated whether they are trijunctions or bijunctions. And, in the case of sub-divisions only poramboke sub-divisions require demarcation.

Principles of demarcation.—The above will show that demarcation with stones is restricted to the extent to which it is essential and to meet the purpose for which the survey is used. No survey can dispense with a minimum of fixd points. If any use is to be made of the survey and if it is to be kept up to date, these points must be preserved.

The Theodolite stations form the frame work of the survey and have necessarily to be maintained. Even if all the field stones disappear, it will be possible to relay

the old boundaries with the help of the Theodolite stations. As regards the other classes of stones, we have every day to use our Revenue survey and consequently must be able to identify fields with rapidity. The essential points necessary to enable such identification are marked by stones and these essential points are the trijunctions and such of the other bends, on the lines connecting which the position of other bends depends. Porambokes—both entire fields and sub-divisions—are to be demarcated and their demarcation maintained with the express intention of preventing encroachment—accidental or deliberate—and of enabling the easy detection of encroachments when made. For the necessity for protection of communal lands see the remarks of the Survey and Land Records Committee—paragraph 16.

Always remember that stones are necessary not so much for survey and mapping as for every day Revenue administration.

Description of stones.—In our Presidency, demarcation is effected by means of stones of durable quality, roughly squared and of the descriptions which you will find given on page 22 of the Chain Survey Manual. You should not, however, always expect to find stones answering exactly to the description given, because in surveys already done the nature of the stones used varied in accordance with local conditions. Where stone was plentiful and cheap, the original survey marks are massive blocks of hard stone. In districts where the Settlement Department did the demarcation, stones were not of a uniform size and did not also bear the broad arrow mark.

Difference between a Revenue field and a survey field.—A revenue field is the administrative and economic unit. A survey field is merely a unit of convenience for the purpose of demarcation and mapping. An occupied revenue field represents a holding. A survey field may comprise one or more holdings. All survey fields are not Revenue fields.

CHAPTER III—FIELD MEASUREMENT.

The next process in survey is field measurement. Read the instructions given in Chapter VI of the Chain Survey Manual. A few general observations are made below.

Surveying is practical Geometry. The basis of all Geometry is the triangle. The triangle is a unique figure. It has a definite size and shape if the lengths of its sides are known. The shapes of the other figures cannot be formed unless the angles are measured in addition. Measurement of lines is easy and rapid; measurement of angles relatively difficult. It is not necessary to measure angles if you proceed by triangulation. Naturally, when survey was first applied to the little fields of South India triangulation alone was used. It is not altogether satisfactory. Hence it was later on modified by the use of the cross staff.

Under either system the triangles formed should as far as possible be well-conditioned. (*Note*—A well-conditioned triangle is one in which the angles are

neither very acute nor very obtuse, that is, the best conditioned triangle is one approaching the equiangular and equilateral shape. The advantage of having the triangles nearly equilateral is that if some of the dimensions are a little out, the resulting error will be less than in the case of an ill-conditioned triangle. When the shortest side of a triangle is less than half the longest side, it may be regarded as an ill-conditioned triangle.) Owing to the configuration of the ground, however, it is not always possible to avoid ill-conditioned triangles.

Simple triangulation violates the great survey maxim—'always proceed from whole to part.' You see this in adding triangle to triangle—the possibility of cumulative error. Hence the system is to measure perimeter first and then fit in the details. You do not add sub-divisions to make a field nor fields to make a village map. The method of simple triangulation violates this rule and that is the worst feature of the system. (2) As every bend has to be connected by a diagonal the measurement of a large number of lines becomes necessary. (3) In many cases it will not be possible to form well-conditioned triangles—this will ultimately affect the shape of the field when plotted. (4) The interior measurements taken for one field are not useful for the adjoining fields. (5) There is no check on the accuracy of the measurements and (6) The task of maintenance is difficult as the nature of the survey necessitates the maintenance of all the stones.

The diagonal and offset system has not these disadvantages. It has therefore been adopted for recent and modern surveys.

CHAPTER IV—MAPPING.

The third process in surveying is 'mapping.' Read the instructions in Chapter VIII of the Chain Survey Manual.

When anything which has to be represented on paper is so large that it would be inconvenient to make a full-sized drawing of it, the drawing or map is made to another scale, that is, each line in the plan is made with a fixed and known proportion to the line it represents.

If a distance of one chain on the ground is represented by one inch on the map, every other detail of the ground is represented by lines drawn in the same proportion. This proportion is called the scale of drawing.

The scale of a map, therefore, is the ratio that the length of a line in the map bears to its actual distance on the ground. The map will be larger or smaller according as the scale contains a smaller or larger number of parts to an inch—*e.g.*, one inch=one chain map will be larger than 1 inch=2 chains map.

The ratio which the measurement of a line on the map bears to its corresponding measurement on the ground, is known by a fraction called the representative fraction. For a scale of 1 inch=1 chain the representative fraction is $\frac{1 \text{ in}}{1 \text{ Ch}} = \frac{1 \text{ in}}{66 \times 12 \text{ in}} = \frac{1}{792}$.

To find the representative fraction of a scale, reduce both the terms of the ratio to a like quantity, as inches. The term representing the measurement on the map will be the numerator and that representing the measurement on the ground will be the denominator. Simplify the fraction until the numerator is reduced to 1 and the result will be the representative fraction. Conversely, if the representative fraction is given, the scale can be found.

Though the entry of the representative fraction on the plan may be enough to enable us to know the scale, some means must be given by which any distance on the plan may be measured off. This is done by means of a graduated straight line called the 'scale.'

A scale is a collection of equal parts used for measuring straight lines and laying down distances each part representing one link, one foot, one chain, one mile, etc., according to the unit assumed.

For a description of the plotting instruments and the method of plotting read Chapter VIII of the Chain Survey Manual.

Hints for plotting.—However well a survey may have been done in the field, it will never appear to its fullest advantage on paper if great care and attention are not bestowed on its delineation. The following hints may, therefore, be borne in mind in preparing a record of the survey work.

Keep the paper on which you plot the field as neat as possible.

The pencil used for drawing should be neither too soft nor too hard. Use a moderately hard pencil, cut to a fine point—chisel-shaped not conical. When being used, it should be gently pressed on paper and slightly inclined in the direction in which the line is being drawn. Care should be taken to keep it in the same position throughout the operation with reference to the ruler.

Never draw a single line that is absolutely unnecessary. Pencil work should always be done as lightly as possible. If the lines are heavy, they are difficult to rub out.

The rubber should be sparingly used. It must be remembered that every use of the rubber erases the paper to a roughness which spoils all subsequent work. Lines drawn on the erased surface are coarse and ragged, attract dust and dirt and detract from the neat appearance of the finished map. Lines wrongly drawn may be scored lightly in pencil by means of dashes. All pencil lines can be rubbed out at one operation after the inking is over.

A rough estimate should be formed of the space which the drawing will occupy with reference to the scale adopted. For this purpose it is sufficient to take the extreme dimensions of the plot.

In entering the figures no attempt at ornamentation is necessary. The figures must be distinct and legible and there should be no possibility of their being misread.

A good plan conveys to the mind a more perfect image than can be obtained by looking at the ground itself. With it the general lie of the plot can be examined and the directions and respective distances ascertained.

In plans there are three things to be desired :—

(1) *Correctness*—without which a plan is worse than useless.

(2) *Clearness*—in order that every part may be understood.

(3) *Beauty of execution*—which adds a great deal to the value of the map.

CHAPTER V—AREA COMPUTATION.

The fourth process in surveying is area computation. Area can be computed in three ways :—

(1) By arithmetical calculation.

(2) By means of the area square paper.

(3) By means of the computing scale.

1 and 2 will be found described in Chapter IX of the Chain Survey Manual. (1) gives the area straight away. In (2) the result depends on two factors, the scale of the map and the scale of the area square paper applied to it. When the two scales differ, the correct area is obtained in the manner described in paragraph 3 on page 52 of the Chain Survey Manual.

When the offsets fall on opposite sides, the difference in area between the portions inside and outside the figure bounded by the G line is found out. See page 56 of the Chain Survey Manual. This difference is additive or substractive according as the longer offset is inside or outside. See fig. 2.

The difference in areas between BEC and DEA is required to be found out.

Cut off CF equal to DA and draw the perpendicular FG. The triangle CFG = Δ DEA.

The difference in area (BEC — FGC) is represented by the trapezoid BFGE. The area of this trapezoid is $\frac{BF\ (FG + BE)}{2}$ or $\frac{BF \times BA}{2}$ and BF is the difference between the two offsets BC and DA.

∴ The difference in area is the chain distance multiplied by the difference between the two offsets divided by two.

In the third method, 'the computing scale,' the result is dependent on three factors—the scale of the plot, the scale of the square paper used and the kind of the computing scale used.

The Computing Scale.

The computing scale is an instrument used for obtaining from maps the areas of fields and other enclosures.

The use of this scale is nothing but the application of the area square paper with the facility that equalisations are made more accurately and the noting of the area of each line is made by the computing scale itself as we work at it.

Two kinds of computing scales are in general use, one for 16″ scale and the other for 40″ scale. Their construction is easily explained. The 16″ computing scale is graduated to a length of 20 inches and reads 10 acres in one sweep. Each main division denotes 1 acre, each minor division one-tenth of an acre or ten cents and each sub-division one cent.

The other scale is also graduated to a length of 20 inches and reads 200 cents or 2 acres in one sweep. Each main division in this scale represents 10 cents, each minor division 1 cent and each sub-division 1/5th of a cent.

Along the centre of each computing scale is an under-cut groove into which is fitted so as to move freely along it a tongue or slide of brass or steel. To this slide is attached a projecting frame which passes over the side of the scale and lies flat upon the paper on which the scale is placed when in use. A handle fixed to the slide enables it and the frame to be moved with facility along the graduated scale. The frame has a fine hair or platinum wire fixed across its centre at right angles to the scale.

To apply the computing scale to the measurement of areas, there should be a piece of transparent paper with lines drawn on it, intersecting each other at right angles and forming squares. How far the lines should be apart is noted on the computing scale itself. In the scale to be used for the 16″ maps, the lines should be one-fifth inch apart. For 40″ maps the lines should be one-fourth inch part, each square representing $2\frac{1}{2}$ cents.

In using the computing scale, the area paper should be placed on the map such that most of the lines on the map fall obliquely to the ruled lines on the tracing paper. The slide should be set to zero and the scale bodily placed so that the hair fixed may equalize the portion left out as well as that included. The slide is then moved to the right until the hair equalizes that portion of the right side within the same pair of horizontal lines. The slider then remaining fixed, the scale is removed bodily to the next set of lines and worked as above. The process is repeated until the slider has passed over the succeeding lines on the area paper for the remaining portion of the field.

The division opposite the hair will indicate the area of the field in acres and cents. If the area be more than that represented by the entire length of the scale, a mark should be made on the area square paper lightly in pencil just below the hair. Remove the scale bodily and setting the slide to zero, set it again so that the hair coincides with the pencil mark made on the paper. Repeat the process until the area of the entire field has been obtained.

Always take care, by placing a weight, that the area square paper does not slip.

How to arrive at the True Area when the Computing Scale is used.

In taking the area with the area square paper alone we are concerned only with two things, the scale of the map and the scale of the area square paper. But

when we use the computing scale, we have in addition to take into account the sort of the computing scale also. If all the three agree—which will be when, for instance, the plot is to a scale 16″ to a mile, the area paper is of the same scale and the computing scale reads with lines 1/5 inch apart, we get the area straight away. But if the computing scale is constructed to one scale and the area square applied is in another scale, while the plan is of the same or different scale, the actual area is obtained as follows :—

Multiply the area obtained by the square of the scale of plotting and divide by the square of the scale of the area square paper. The result obtained should be multiplied by the scale of the area square paper and divided by the scale of the computing scale. A field is plotted to a scale 1″= one chain. The area is taken with area square paper 1″ = 2 chains and computing scale of 1″ = 5 chains; and suppose the area obtained is 2 acres.

Multiply 200 cents by the square of the scale of map which is 1.

Divide by the square of the area paper

$$\frac{200 \times 1^2}{2 \times 2} = \frac{200}{4} = 50.$$

Then multiply by 2 and divide by 5.

$$\frac{50 \times 2}{5} = 20 \text{ Cents.}$$

When the plotting is to one scale but the area square paper used and the computing scales agree, the difference will be in proportion to the square of the scales of the plotting and the area paper.

CHAPTER VI—ANGULAR SURVEY.

Why Village and Khandam Boundaries are surveyed by an Angular Instrument.

The method of surveying by the chain and cross staff is very slow and is accurate only under certain conditions. It is impossible in the nature of things for the survey to be mathematically accurate and the larger the extent to be surveyed the greater will be the amount of accumulating error. It is not suitable in a country where many obstacles impede the view or render horizontal measurements difficult.

Surveying with an angular instrument enables us to achieve the utmost accuracy possible both in measurement and mapping with greater economy of time, labour and expense. The angular instrument obviates the necessity of taking measurements across country and provides a number of accurate and fixed points for the detailed survey of fields. "The use of an angular instrument while securing extreme accuracy renders unnecessary the measurement of those lines which in a chain survey are measured only to enable the work to be plotted. With the Theodolite a sufficient number of angles is taken to enable the work to be plotted

and also to give a check in the same way as the tie lines, offsets, etc., act as a check in a chain survey." Hence village and Khandam boundaries are always surveyed by means of an angular instrument, the Theodolite.

DEFINITIONS.

In order to understand the use of the Theodolite and the circumferenter it is necessary to know the definitions of certain terms which are commonly used in connection with a Survey with these instruments.

A circle is a plain figure bounded by a continuous curved line, called the circumference which is everywhere equally distant from a point within called the centre.

A tangent to a circle is a straight line which touches the circumference of the circle in one point only and being produced does not cut it.

The earth is an oblate spheroid, *i.e.*, a body approximating a circle but not a perfect circle.

The imaginary line passing through the centre of the earth and upon which the earth rotates is called the axis of the earth.

The two ends of the axis of the earth are called the poles—the one on the north being called the north pole and the other on the south the south pole.

The horizon is the circle which bounds the view of the earth's surface to a spectator on a level surface.

The zenith is the point in the heavens directly above the head of the observer.

The nadir is the point in the heavens directly below the feet of the observer; hence opposite to the zenith.

The horizontal circle is a circle whose plane is a tangent to the earth at the place of the spectator.

A horizontal angle is the angle formed by the inclination of two straight lines in the plane of the horizontal circle or in one parallel thereto, which meet in its centre.

A vertcial circle is a great circle which passes through the zenith and nadir of a place and is consequently at right angles to the horizontal circle.

A vertical angle is the angle formed by the inclination of two straight lines in a plane of the vertical circle which meet in its centre.

Meridians are imaginary lines drawn round the earth and passing through the poles.

A magnet is a loadstone *i.e.*, an ore of iron which has the peculiar properties of attracting iron and of pointing to the poles when freely suspended. It has also the power of communicating these properties to iron and steel thus forming artificial magnets.

The magnetic needle is a small bar of iron or steel which is magnetized. Hence the properties of a magnet having been communicated to it, its magnetized

ends point to the poles—the positive end to the north pole and the negative end to the south pole.

The direction in which the magnetic needle points is termed the magnetic north.

The magnetic north differs from the true north by sometimes several degrees east or west of it, depending entirely upon the geographical position (and not local attraction) of the country where the needle is set up. This angular difference is known as the variation of the needle.

The variation of the magnetic needle is the angle which the magnetic north makes with the true north at a point either east or west of it.

The magnetic meridian is a great circle parallel with the direction of the magnetic needle and passing through its poles.

The bearing of a line is the angle which the line makes with the meridian at a point on it and is usually reckoned from the north at O by the east, west, south and back to 360 degrees.

The true bearing is the angle made with the true north and the magnetic bearing is the angle made with the magnetic north.

CHAPTER VII—THEODOLITE.

By far the most useful instrument to the surveyor and also the most valuable is the Theodolite.

This instrument is devised for measuring horizontal and vertical angles *i.e.*, the angles subtended by any two objects at the point of observation, and the angles of elevation or depression of an object situated above or below the horizontal plane at the point of observation. These are also known as 'azimuths' and 'altitudes.'

Theodolites are always designated by the diameter in inches of their engraved horizontal circles. In the Madras Survey Department the 'Everest' pattern of 5″ or 6″ Theodolite is used.

In geodedic triangulation Theodolites have been used with circles as much as 36 inches in diameter.

The instrument consists of distinct parts each of which may be separately described.

The Stand:—There is a stand which supports the instrument when in use. This consists of a wooden triangular frame on which is fixed a metal triangular plate. The legs are fastened to the three corners of the frame with a metal bolt passing through the frame and the heads of the legs, each of which in its turn consists of two pieces of wood separate at the top where they join the frame, and coming together at the foot where they end in a point shod with iron. Half way down there is a small bar of wood joining them and making them firm. The metallic triangular plate consists of a lower plate with three cups to receive the footscrews of the Theodolite and an upper securing plate with three holes in it to lock the foot-screws either by a spring arrangement or by the tripod clamping screw.

The instrument itself consists of two main parts, the upper and the lower.

Lower Part :—The lower part begins with the three footscrews which work in a tribrach. The boss of this tribrach is pierced to allow the vertical or azimuthal axis to work in it, and has attached to it two arms—one carrying the lower horizontal clamp and tangent screw, and the other, the upper horizontal clamp and tangent screw. Then comes the horizontal plate or the lower plate having graduations marked on a silver circle called the horizontal limb. It is graduated to 360 degrees round the edge and is the base of the instrument. It is free to turn round the azimuthal axis above referred to and is fixed in any desired position by the lower clamp and tangent screw.

Over this plate fits a thin circular plate called the upper plate or the vernier plate. This nearly covers the lower, lies flat on it and turns on the same axis but freely and independently. It has its own clamping and tangent screws by which it can be fixed to the lower plate so as to turn with it as one piece when required to do so. This plate carries three silver graduated horizontal verniers and three moveable horizontal lenses for reading the graduations.

Over this plate is fixed the horizontal level by means of the capstan headed or drawing screws. By means of this level the two plates are together adjusted to a horizontal plane by the use of the footscrews.

At the upper end of the vertical axis is a horizontal bar from whose ends spring up two low supports called Y's to which are attached cleats.

On the Y's rest the pivots of the horizontal axis. These pivots are locked in position by the cleats. Midway between the pivots and at right angles to the horizontal axis lies the telescope carrying with it two arcs of the vertical circle or limb. To the horizontal axis is also attached an arm carrying at its ends two verniers. On the arms is fixed the vertical level. The whole is fixed in position by means of two screws called clips or antagonistic screws which work in opposite directions against a shoulder between them.

The vertical arcs and the vertical vernier are also of silver and graduated and are read by means of the vertical lenses.

Another arm on the horizontal limb carries the vertical clamp and tangent screws which fix the telescope in position when making an observation.

In the telescope itself there are the eye piece, the object glass with its cap and a mill headed screw which carrying a *pinion* and working in a racket attached to the sliding tube of the telescope affords the means of nice adjustment for focus. To the upper part of the telescope is attached a compass box when magnetic bearings are taken.

At the eye end immediately in front of the eye piece is a diaphragm which is held in its place and adjusted by two capstan headed screws called Collimating screws. To the diaphragm are attached the cross wires which are either fine spider's webs fastened on with varnish or fine lines scribed on a glass disc. When

the telescope is properly focussed the image of the object observed coincides with the diaphragm. This image is viewed through the eye piece which magnifies it. The eye piece is adjusted by drawing it out or pushing it in until a clear view of the cross wires of the diaphragm is obtained.

The vertical arcs indicate the face of the instrument. A Theodolite is said to be 'face left' or 'face right' according as the vertical arc is to the left or right of the observer standing at the eye end of the telescope.

The various parts of the Theodolite, therefore, are :—

Tripod stand—with bolt, triangular plate and clamping screw.
Three footscrews.
The tribrach
Lower arm—with clamp and tangent screw.
Upper arm—with clamp and tangent screw.
Lower horizontal limb.
Vernier plate.
Vernier lenses.
Horizontal level fixed by capstan headed screws.
The Y's.
Cleats.
Clips.
Horizontal axis ending in pivots.
The arm with the vertical verniers.
Vertical arcs and lenses.
Vertical level.
Vertical clamp and tangent screw.

The telescope, eye piece, object glass with cap, mill headed screw, diaphragm with collimating screws.

The Theodolite is of various types. The two types we commonly meet with are the 'Transit' and 'Everest' patterns. The latter is the one most in use in the Madras Survey Department. The distinguishing features of the 'Transit' Theodolite are that the telescope can be rotated vertically end for end, the vertical circle is complete and is graduated throughout its circumference and both the horizontal and vertical circles are graduated to a greater degree of minuteness. The 'Transit' is largely used to take observations to the Sun for true bearings.

ADJUSTMENT.

In the case of every surveying instrument we have to make sure that by using it we can get accurate results. There are likely to be mistakes in the instrument itself. This must be verified as soon as an instrument has newly come into the hands of the surveyor and also whenever there is reason to suspect that the instrument has been shaken or has met with any accident likely to have disturbed it. The verification of these and their rectification are known as the 'permanent

adjustments' of the Theodolite. Also, whenever the Theodolite is used, we have to make sure that the instrument is exactly over the station the angle subtended at which is required to be measured, that the horizontal level at which the angle is measured is correct and that we make no mistakes in observing the objects. Every time, therefore, the instrument is set up for use, some adjustments of the instrument are necessary to secure accurate results. These are known as the 'temporary adjustments.' Both the temporary and the permanent adjustments are described below. The latter demand greater skill and experience in the handling of the instrument and should not therefore be attempted by beginners.

The temporary adjustments are :—

(1) Centering.
(2) Obtaining distinct vision of the wires.
(3) Eliminating parallax or "finding focus."
(4) Levelling, that is, making the vertical axis perpendicular to the horizon.
(5) Setting to zero.

1. *Centering* :—Place the tripod stand over the station of observation with its legs wide apart, so as to give a firm base and with its head as nearly level as the eye can judge, so as to avoid bringing undue strain on the footscrews. Lift the instrument on to this and suspend the plummet by the string from the hook at the bottom of the instrument; and, by moving the legs of the stand bring the plummet exactly over the plummet hole on the top of the station, observing at the same time that the Theodolite continues to be roughly level.

2. *Obtaining distinct vision of the wires* :—Remove the cap of the telescope, always by the screw (not the unscrew) motion—so as not to displace the object glass in its cell; direct the telescope to the sky and observe the wires on the diaphragm through the eye-piece, pushing it in or drawing it out until the wires are seen with perfect distinctness. The eye-piece also should always be moved in a screwing up motion to avoid any chance of its coming out.

3. *Eliminating parallax* :—Parallax is an apparent change in the position of an object caused by change of position in the observer. Turn the telescope in the direction of any distant and well defined object, look through the eye end and by means of the milled head draw the telescope out until the object is nicely seen. Clamp, that is, tighten the three clamps and interest the object by bringing it in the centre of the wires by means of the upper horizontal and vertical tangent screws. Now, imagine the wires to be fixed and move your head laterally as far as the field will admit, while your eye is intently watching the intersection of the object by the wires. According as the object appears to move or otherwise from the centre of the wires, so is it said that there is or is not parallax. If, when the eye is moved to the left, the object also appears to move to the left then the focus of the object glass is beyond the wires and the object glass must, therefore, be brought nearer to the eye-piece. If, when the eye is moved to the left, the object appears to move to the right, then the focus is too near and the object glass must be moved further away from the eye-piece.

The principle of the adjustment is that the foci of the object glass and the eye-piece should coincide on the plane of the wires. An image of the field of view is formed in the telescope and until it coincides with the plane of the wires changes in motion will take place; just as, when looking out of a window the position of the bars with reference to the landscape changes according as we change our position; but if the landscape was painted on the glass (*i.e.*, was in the same plane as the bars) this would not be the case. By moving the object glass in and out, or as it is called 'focussing' the image is moved backwards and forwards in the telescope until it coincides with the plane of the wires where there can be no motion and the eye-piece which is merely a magnifier, having been set to see the wires distinctly, will also show the picture as distinctly.

Note that the proper position of the eye-piece varies with the eyesight of the observer but not with the distance of the object while the position of the object glass is unaffected by the eyesight of the observer but varies with the distance of the object.

4. *Levelling*:—Place the horizontal level parallel to two of the footscrews and bring the bubble to the centre of its run by moving them both either inwards or outwards according as the bubble should move to the right or to the left.

Then turn the instrument 90 degrees or a quarter round. If the bubble is not in the centre bring it to the centre by moving the third footscrew inward or outward.

Then bring the instrument to its first position and if the bubble does not continue to be in the centre, the instrument must again be levelled by means of the first two footscrews.

Repeat the above process until the bubble remains stationary in the middle during a whole revolution. If it does not, it indicates that the horizontal level requires permanent adjustment.

5. *Setting to Zero*:—Setting to zero means that any given point shall read a given reading on the limb. If you desire to read the angle between two objects, you achieve the same result whether you intersect the first station with zero and then measure the angular distance to the other object, or you read any other angle at the first station and continuing the observation to the other station find out the difference between the two and note it as the angular distance between the two objects. 'Setting to zero' therefore is a technical expression meaning that any given point is made to read any given reading on the limb.

For this purpose, after levelling the instrument make the arrow of the A vernier correspond exactly with the given reading or with zero by means of the upper horizontal clamp and tangent screw. Next unclamp the lower horizontal clamp and turn the telescope by the horizontal plate until the given object is nearly on the wire. Now clamp the lower horizontal clamp and intersect with its tangent screw. The zero will now be set.

Permanent Adjustments.

The permanent adjustments of the Theodolite are three in number.

(1) Setting the horizontal level parallel to the horizontal plate.

(2) Collimating in azimuth.

(3) Setting the vertical level parallel to the zero of altitude of the vertical arcs.

(1) Setting the Horizontal Level.

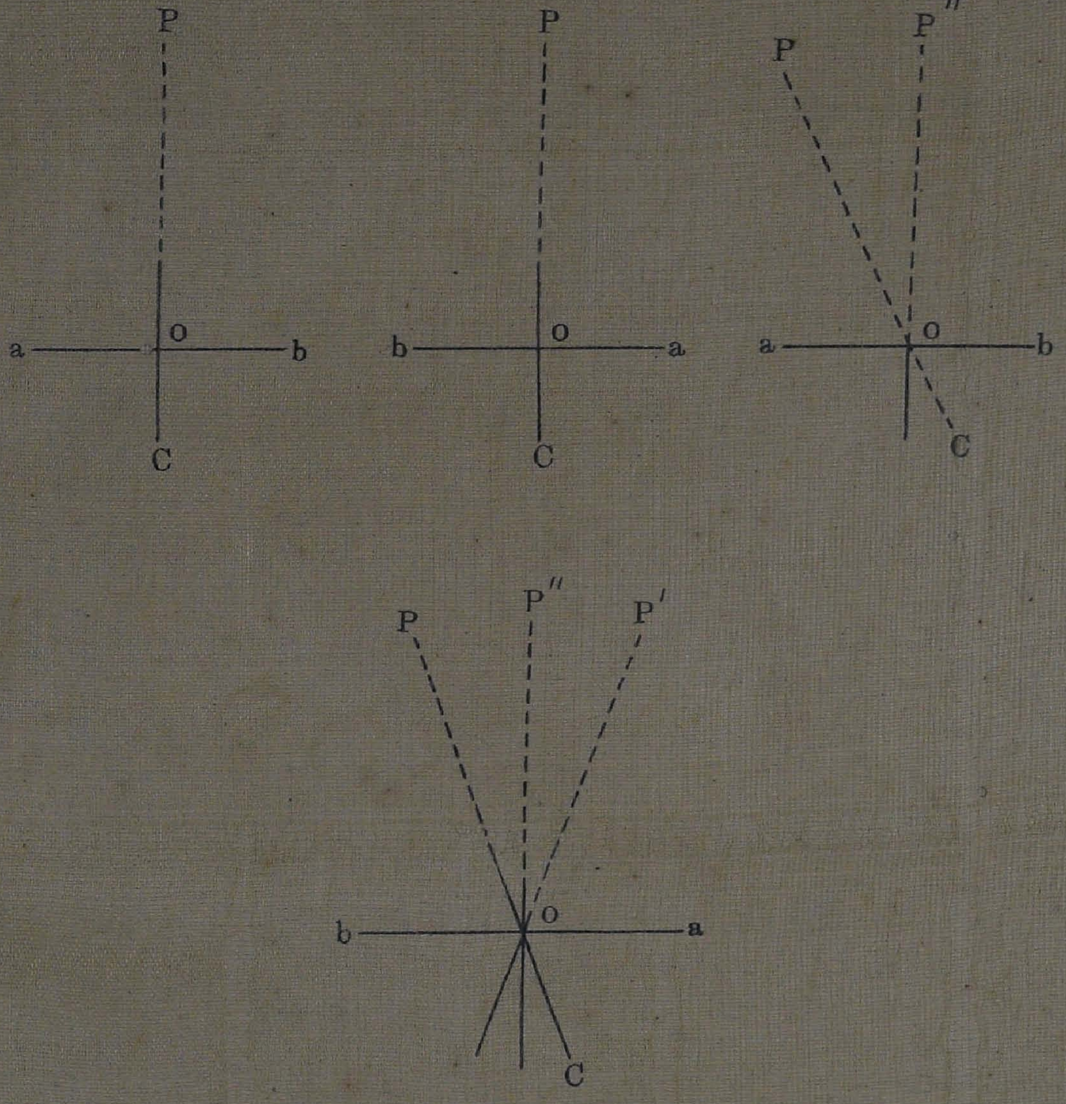
By this is meant making the two horizontal plates truly horizontal and the vertical axis truly vertical. Both these conditions are secured only when the level is parallel to the horizontal plate. When this is assured, the setting right of the horizontal plate in a level plane ensures the verticality of the vertical axis and consequently the horizontality of the transit axis as well. The adjustment is effected by means of the spirit level attached to the upper or vernier plate. Level the instrument as explained under temporary adjustments. Turn the telescope so as to place the horizontal level parallel to two of the footscrews and by their motion bring the bubble to the centre of its run. Now rotate the instrument horizontally through 180 degrees and see if the bubble continues in the centre. If it does, the level is in permanent adjustment. If not, the spirit level is not parallel to the upper plate. Half the error is then adjusted by means of the first two footscrews and the remaining half by means of the capstan headed adjusting screws at the end of the level. Bring the level back to its first position and correct any deviation as before half by the footscrews and half by the capstan headed screws. The operation should be repeated until the bubble remains in the centre while the instrument is rotated into any position.

This adjustment is performed wholly by means of the adjusting screws at the end of the tube. The distance through which the bubble moves away from the centre of its run is proportional to double the error of the level tube, so that to correct the whole error it is necessary to move the bubble through only half its deviation from the centre by means of the adjusting screws. The footscrews do not in any way alter the relative inclination of the level tube and vertical axis, and the object of using them through half its deviation from the centre is so that on completion of the adjustment the bubble will be in the centre of its run, or, in other words, in the proper position for retrying the accuracy of the adjustments.

(2) Collimating in Azimuth.

The line of collimation is the imaginary straight line joining the intersection of the wires with the optical centre of the object glass. This line must be exactly perpendicular to the horizontal axis about which the telescope rotates. The error of collimation is the deviation of the above straight line, or, the optical axis of the telescope, from perpendicularity to the line joining the pivots. The object of the adjustment is to remove this error.

Fig. 3



See fig. 3. Let *aob* represent the horizontal axis of the telescope and COP the collimation line. If this line be really perpendicular to the horizontal axis, when the telescope is lifted out of its bearings and replaced with the ends of the horizontal axis *ab* reversed into the position *ba* the collimation line must still be directed on to P. If, however, the collimation line be not perpendicular to the horizontal axis *ab*, when the horizontal axis is reversed into the position *ba* the line will no longer be directed on to P but on some other point as P′. In this case the point P″ midway between P and P′ is the correct position of the collimation line perpendicular to *ab*. The method of adjustment consists in bringing the line to the position indicated by COP.

This adjustment is done in two ways :—

(1) By changing pivots—the process being used for all small Theodolites the telescope of which cannot revolve through a complete vertical circle.

(2) By changing face—this is only applicable to a Theodolite of which the telescope can revolve through a complete vertical circle—a 'Transit' Theodolite.

(1) By changing Pivots.

Go through the temporary adjustments and intersect a well defined object. Read the horizontal angle. Throw open the cleats, release the clips, raise the telescope gently out of the Y's and turn its verniers through a semicircle bringing the clips uppermost. Now change the pivots to bring the clips lowermost. Replace the telescope gently, the object end still pointing towards the object. If the telescope in this position still intersects the object the instrument is in collimation. If not, intersect the object correctly by means of the upper tangent screw. Read the horizontal angle. Take the mean of the two readings and set the vernier to that quantity by the upper tanget screw. Look through the telescope. The intersection of the wires will be found to be either to the left or right of the object. Correct this by moving the diaphragm by the collimating screws till the wires intersect the object.

Again change pivots and repeat the above process until the intersection remains constant on changing pivots.

Always remember that the real is half the apparent error.

The only objection to this method is the practical difficulty of reversing the pivots without some jar or shake which would vitiate the observation. Extreme care is, therefore, necessary in the operation.

(2) By changing Face.

This method is suitable to 'Transit' Theodolites only whose telescope can revolve through a complete vertical circle.

Intersect any fixed object and note the reading as before. Turn the telescope through 180 degrees vertically, *i.e.*, end for end on its horizontal axis so as to bring the object glass where the eye-piece was before. Then turn the upper part of the

instrument and intersect the object and read the angle. The two readings must differ exactly by 180 degrees. If they do not, the error must be noted. The plates must be set to read the mean of the two readings and the deviation in the intersection should be corrected by moving the diaphragm by the collimating screws.

This method is affected by any errors of graduation that may exist in the division of the limb.

In actual work collimation error is avoided by reading angles on both faces of the instrument and taking the mean of the readings.

(3) Setting the Vertical Level.

This level should be parallel to the line of collimation. When the line of collimation is horizontal and the zero lines of the vertical verniers coincide with the zero diameter of the vertical circle, the bubble must be in the centre of its run. To secure this, after having performed the two previous permanent adjustments bring the bubble of the vertical level to the centre by means of the clips, intersect an object and read the vertical angle.

Change pivots, level the instrument as before, intersect the object and read the vertical angle again. If there is no difference between the two readings, then the vertical level is correct. If there is difference take the mean of the two readings and set the vertical vernier to that quantity by the vertical tangent screw. If you now look through the telescope, the object will be either above or below the intersection of the wires. By means of the clips make the wires intersect the object. The bubble in the vertical level would have been thrown out. Bring the bubble to the centre by the capstan headed or drawing screws of the level.

Change pivots and repeat the process until the vertical reading on both faces of the instrument is the same. Then the level will be set. The difference in readings noticed during the operation is due to the line of collimation not being horizontal when the bubble is in the centre of its run and when the arc reads zero. This difference is twice the angle by which the line of collimation deviates from the horizontal, and the mean of the readings gives the true angle from the horizontal of the observed object. The difference between the mean reading and either of the observed readings is the actual vertical angular error of the collimation line and the line of collimation is moved through this angle or, in other words, brought on to the object by means of the antagonising screws. This movement of the screws throws the bubble out of the centre by an amount corresponding to the angle moved through, *i.e.*, corresponding to the error. By correcting this deviation of the bubble wholly by the screws at the end of the bubble tube the latter is made parallel to the line of collimation, which is therefore horizontal when the adjusted bubble is in the centre of its run.

Method of Observing Horizontal Angles.

In making any observation for a horizontal angle we have three stations—the station of observation and the other two, the stations the inclination between which is required to be measured.

To measure this inclination, set up the Theodolite stand over the place of observation with the head as level as the eye can judge. Push the triangular plate back with the thumb to receive the feet of the Theodolite. Dust the cups well. Lift the Theodolite on to its stand by catching the Y's firmly by both the hands, insert the heads of the footscrews which are turned downwards into the holes of the lower triangular plate, push the upper triangular plate back to its original position with the thumb ; when there is a clamping screw, clamp the stand.

Go through the following temporary adjustments :—Centering, obtaining distinct vision of the wires, eliminating parallax and horizontal levelling.

Clamp the lower horizontal clamp. Intersect the back station. Take the horizontal reading and enter it in the field book. This will be the zero of observation. Release the upper plate, intersect the foward station by using the upper tangent screw and record the horizontal reading. Keeping the upper plate clamped release the lower plate and intersect the back station by the lower tangent screw. The reading of the arc should not be altered by so doing. Nevertheless, it should be verified. Release the upper plate and intersect the forward station and note the reading. Then by subtracting the first from the second reading one measure of the forward angle is obtained and by subtracting the second from the third reading another measure is obtained. Both the readings are recorded in the field book as below and if they do not agree within the minimum graduation of the Theodolite, a third measure of the angle should be taken and recorded.

$$\left.\begin{array}{l}284^\circ\text{—}55'\\191^\circ\text{—}40'\end{array}\right\}266^\circ\text{—}45'$$

$$98^\circ\text{—}25' \quad 266^\circ\text{—}45'$$

N.B.—In reading a vernier it is often difficult to decide at which of the adjacent divisions the coincidence occurs. Get the centre of the magnifying glass by which the vernier is read exactly opposite the supposed coincidence and then draw the eye back from the glass. This will still more magnify the lines and the coincidence is where there is no break in the lines of the vernier and primary scales. The two should appear as one unbroken line.

The instrument can then be removed to another station and the observations continued.

CHAPTER VIII—VERNIER.

In describing the Theodolite mention has been made of the lower horizontal plate whose limb is graduated completely from 0 to 360 degrees. Conceiving oneself to be standing within the circle the graduations would appear increasing from left to right. There is also the upper horizontal plate which has only a portion of the arc graduated. The zero of the vernier is marked by an arrow. The two plates together enable us to measure the angle subtended at the place of observation by two objects. If, for instance, the zero of the vernier and the zero of the

limb are made to coincide and to point exactly to one object, and the telescope is turned to the other object, that is to say, the upper plate alone is turned until the telescope points to the other object, the number of graduations that the upper plate has passed over the lower which has been kept firm, is the angle subtended by the two objects observed. The angle is read by noting the number of degrees, etc., pointed by the arrow of the vernier. It is just possible that the arrow of the vernier does not exactly point to one of the divisions on the lower plate. In such cases the graduations in the vernier enable us to know the aliquot parts of the division of the lower limb. In other words, the verniers enable us to read the angles to a greater degree of minuteness than is possible with the help of the lower limb alone. If the graduated limb of the Theodolite is divided into degrees, half degrees or third parts of a degree you can with the help of the vernier read the minutes less than 30′ or 20′ as the case may be. The mode of construction of the vernier which enables this to be done will be described below. It may be noted at the outset that this contrivance is known as the vernier because the inventor was a person named Peter Vernier of France (invented in 1630).

The general principle of the construction of the vernier is better understood by a concrete illustration.

Let us take the case of a Theodolite whose horizontal limb is divided into degrees and half degrees. Each division, therefore, of the limb is 30 minutes. Take a space of 29 such divisions or equivalent to 870′. Divide the same space into 30 divisions. Adopt the latter as the vernier scale. A distance of 870 minutes having been divided into 30 divisions, each division of the vernier is 29′ and is 1 minute less than each division on the limb. Put the vernier scale over the limb such that the zero of the vernier coincides with the zero of the limb. Then, because the space between the zero of the vernier and its first division is 29′ while the space between the zero of the limb and the first division thereof is 30′, therefore, the first division of the vernier falls behind the first division of the graduated lower limb by 1′. Similarly, the second division of the vernier will be 2′ behind the second division of the graduated limb and so on, the 30th division being 30′ behind.

Now, let us make the first division on the vernier coincide with the first division on the lower limb. It is obvious that the arrow of the vernier will have passed the zero of the lower limb. How much has it passed? A distance equal to that which the first division of the vernier had to pass so as to coincide with the first division on the limb, namely, 1 minute. Similarly, if the 2nd division mark on the vernier is made to coincide with the second division from zero on the lower limb, the arrow of the vernier should have passed the zero of the lower limb a distance of 2 minutes —which is the distance indicated also by the coinciding line of the vernier; and so on, for any number of divisions. If therefore, at any reading if the arrow of the vernier does not exactly coincide with any division on the lower limb, you have only to look along the vernier to know the number of minutes it has passed beyond the division of the lower limb immediately preceding the arrow of the vernier

The latter will give the number of degrees and half degrees passed and the coinciding division of the vernier the number of minutes passed over and above. Similarly, to make the Theodolite read any number of minutes, it is only necessary to bring the division of the vernier corresponding to the required number of minutes and make it coincide with the division on the lower limb which is just ahead of it. The divisions marked on the vernier are the aliquot parts of the lowest division in the lower limb.

The vernier may therefore be defined as a contrivance attached to the graduated limb of an instrument for the purpose of measuring the aliquot parts of the smallest spaces into which the instrument is divided. It obtains this object by measuring the difference between two scales one of which is fixed and called the primary scale and the other movable and called the vernier.

The general principles of the construction of the vernier may also be stated as follows :—

Let a be the length of a division on the primary scale
b the length of a division on the vernier scale
and n the number of divisions on the vernier.

Then $(n - 1)\, a = nb$

or $n\, a - a \quad nb$

or $a - \frac{a}{n} = b$

b is therefore less than a by $\frac{a}{n}$

This formula will enable us readily to know the proper number of divisions for the sort of vernier required.

If the primary scale is divided into 10 minutes and the vernier is required to read to 10 seconds, since the vernier measures only by the difference between the two scales, a (the division on the lower limb) — b (the division on the vernier) is required to be 10 seconds.

$a - b = 10''$
a itself is $10'$

$\therefore a - b \quad \frac{a}{60}$ or $60a - 60b = a$ or $59a = 60b$

Take, therefore, 59 divisions on the primary scale and divide the space into 60 divisions for the vernier.

In as much as the vernier reads only by the difference between two approximating scales, the object might be equally attained if n divisions are taken on the primary scale and formed into $n - 1$ divisions for the vernier. The result will be, that each division in the vernier will be ahead of the division of the lower limb by $1/n$ th part and the correct reading could only be got by reading in a direction contrary to that on the lower limb. This method is not, therefore, generally adopted.

CHAPTER IX—GALE'S TRAVERSE SYSTEM.

In a chain Survey you are concerned with the measurement of distances only. In an angular survey either the bearings of the lines, *i.e.*, the angles which they form with the magnetic merdian or the angles formed by the station lines themselves one with the other are measured together with, in each case, the distances themselves. Angular survey is, as you know, resorted to when the tract to be surveyed is extensive in area and where great accuracy is necessary. The object of every survey is to map the portion surveyed and calculate its area.

Mapping or protracting a map from the field book can be done under the chain and angular survey

(1) by linear protraction
(2) by angular protraction
or (3) by the method of co-ordinates.

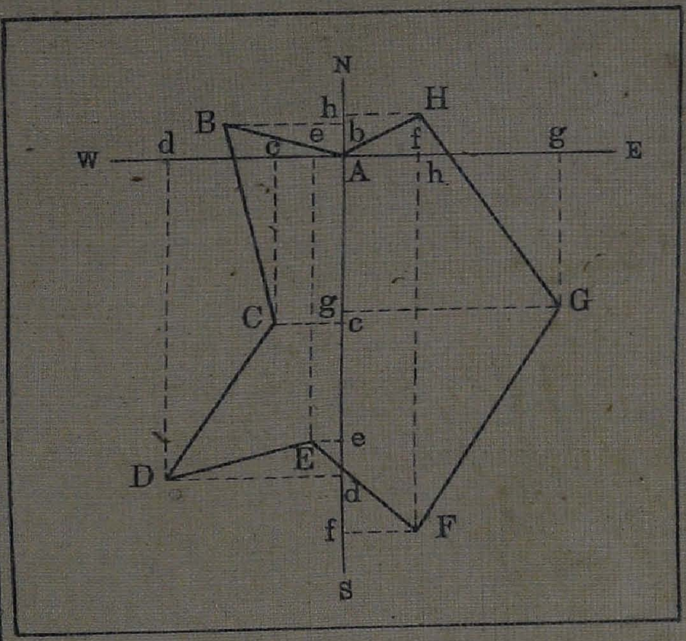
1. *Linear protraction.*—When no angles are taken the survey consists of a system of triangles and trapezoids all the sides of which are measured and which are plotted one from the other. The application of this method of survey is limited by the size of the tract to be surveyed and the natural and artificial features of the locality.

2. *Angular protraction.*—When the angles which the station lines form with one another are measured, the field surveyed can be mapped with the protractor. But this method is subject to error. The angles themselves cannot be accurately laid and any fault committed in any stage of the work is increased through every following step so that there may accumulate as many multiplied errors as there are successive lines to be protracted; that is, each line will be affected by the sum of all the errors committed in the preceding stages of the work.

Instead of taking the inward angles it is possible to survey by taking the bearing of each line, *i.e.*, the angle which it makes with the magnetic meridian. Such a survey can be plotted with the help of a protractor. This necessitates the drawing of a meridian line at each station point, the laying out of the bearing with the protractor and the plotting of the measured distances. In this plotting the position of each station depends upon the accuracy with which its bearing and distance have been protracted from the station immediately preceding. An error in the position of each station affects all those which follow but only to the amount of the error itself. There are likely to be mistakes in drawing the parallel meridians, in protracting each successive bearing and in plotting the distances.

3. *Method of Co-ordinates.*—Plotting by means of right angles and perpendiculars is easier and less liable to error. The distances due north or due south or due east or due west of one station with reference to another are the perpendicular distances north or south or east or west. If, therefore, it can be found out how far due north or south, and east or west each station is from the preceding one, the work can be rendered less liable to error. Thus in figure 4 NS being the meridian

Fig: 5



Sub Circuit No. 4

△ F 1449 117°48 242°12 △ E
1740 317°46 4214 △ D
2385 136°49 223°11 △ C
20°55 294°35 65°25 △ B
1238 137°46 222°14 △ A

Sub Circuit No. 3

Village Circuit

Village Circuit No. 2

913 267°29 92°31 △ H
2490 240'51 119°09 △ G
3036 286°55 73°05 △ F

Village Circuit — Sub Circuit

1238

222°14 | 48°52

△ A

line through A, the first station, and N_1S_1 a parallel meridian through B, the second station in the survey, if we can find out MB which represents how far B is due north of A, and can also find AM which is the distance B is due east of A, the plotting work is so much rendered the easier and less liable to error; for, then it will be only necessary to draw a meridian through A, draw another line AE at right angles, cut off AM the calculated easting and lay off MB, the calculated northing. The position of B will then be fixed. The position of C with reference to B can be similarly fixed by calculating MQ and QC, and so on for the other stations. This method again requires the drawing of a parallel meridian line at each successive station.

If the method can be so improved as to avoid even this liability to error the plotting is bound to be so much the easier and more accurate. If the distances of each station due north or south and due east or west can be calculated with reference to station A, the station of origin, you will require to draw only one N and S line and another E and W line at right angles to it and determine the positions of all the stations easily. For instance, if in the same figure,

AM and MB, AQ and QC and AT and TD can be calculated, these can be laid out easily. That these are capable of calculation will be clear from a perusal of the figure. Each station will thus be separately referred to the meridian of origin, both for distances due north or south and for distances due east or west. Any error which may occur in laying down one point is not carried on through the series, the fixing of that point being an isolated operation independent of any other in the survey. This last method of plotting is secured by the adoption of what is known as the Gale's Traverse System. It is invariably resorted to when a Theodolite is employed on the traverse. The quantity which one end of a line is due east or west of the other is called 'Departure' or, its easting or westing as *b*B, *c*C, *e*E. The quantity which one end of a line is due north or due south of the other is called 'Latitude,' or, its northing or southing as A*b*, *bc*, *de* (Figure 5).

Mode of Traversing.

In traversing a plot as in Figure 5 the Theodolite is set up at station A, the bearing of the line AB is taken. The included angle HAB is read following the method described for observing horizontal angles. The Theodolite is then removed to B and the inward angle ABC is similarly recorded. The same process is repeated in all the other stations.

The accuracy of a circuit will depend on the fulfilment of three conditions:—

(1) Sum of all the inward angles must be equal to twice as many right angles as the figure has sides less four right angles.

(2) The sum of the 'northings' or distances travelled north must be equal to the sum of the 'southings' or, distances travelled south.

(3) The sum of the 'eastings' or, distances travelled east must be equal to the sum of the 'westings' or, distances travelled west.

The fulfilment of the first condition can be verified immediately the survey has been completed. In actual practice, this condition will not be absolutely fulfilled. It is, therefore, usual to apply certain corrections to the angular work. The total error being known, a minute here and there is added to or subtracted from, the largest angles.

The other two conditions can be verified only after some calculations which are explained below, have been made. But the truth is self-evident that if you start from a certain place on the earth's surface, proceed in different directions and come back to the starting place, the distances travelled due north and due south must be equal as also the distances travelled due east and due west. What these distances are require to be calculated.

A perusal of Figure 5 will show that the difference in latitude of B with reference to A is the quantity represented by A*b* and the difference in departure or longitude is the quantity represented by *b*B.

A *b*/AB (Distance) = Cos of the angle AB*b*.

∴ A*b* or difference of latitude = AB (Distance) Cos. BA*b*:
angle BA*b* is equal to the bearing of the line AB *viz.*, NAB deducted from 360 degrees.

$$\frac{bB}{AB} = \text{Sin BA}b.$$

∴ *b*B or difference of departure = AB (Distance) × Sin BA*b*. Similarly, *bc*, latitude of C with reference to B is equal to BC (Distance) × Cos CB*c* (bearing of the line BC) deducted from 180 degrees; and *c*C or departure = BC (Distance) × Sin CB*c*.

The difference in latitude of E with reference to D is *de* which is equal to DE (Distance) × Cos *e* DE which is the bearing of DE.
*e*E or departure = DE (Distance) × Sin *e*DE.

It will thus be seen that the latitude and departure are the product of the measured distance and the cosine, and of the measured distance and the sine respectively, of the actual bearing, or the bearing reduced to a lower quantity. It is, therefore, necessary to know the actual bearing of each line of the traverse.

But in actual survey we take the bearing of only the first line of the traverse. The bearings of the other lines can be deduced from the bearing of the first line.

To find out the bearing of BC (*see figure 6*) N_1S_1 is the meridian through B parallel to that through A. < ABS_1 = < BAN.

Outward < S_1BA = outward < NAB (observed bearing of AB).
Add included angle ABC.
Outward < NAB + < ABC = S_1BC (outward angle).
= N_1BC + 180 degrees.
= bearing of BC + 180 degrees.

∴ observed bearing of AB + the observed inward angle at B = bearing of BC + 180 degrees.

∴ The bearing of B C = the sum of the observed bearing of the preceding line and the interior angle at B diminished by 180 degrees.

Bearing of the Line CD.

Draw N_2S_2—meridian through C
$< S_2CB$ = observed bearing of BC
Add included < BCD and deduct 180 degrees ($< S_2CN_2$)
you get N_2CD which is the bearing of CD.
$< S_3DC$ = the bearing of CD.
Add included angle CDE and deduct 180 degrees.
you get $< N_3DE$ which is the bearing of DE.
$< S_4ED$ = the bearing of DE
Add included angle DEF
Add 180 degrees to the total,
you get $< N_4EF$ which is the bearing of EF.

So then the bearing of one line and all the included angles being given, the bearings of all the other lines can be deduced. The general rule is as follows :—

"To the bearing of the line preceding that of which the bearing is sought add the inward angle formed by these two lines and the sum increased or decreased by 180 degress according as it may be less than or in excess of 180 degrees, will be the bearing of the next line. If the sum be 540 degrees or more, deduct 540 degrees from it for the next bearing, and if 180 degrees exactly, subtract 180 degrees from it."

As soon as the bearing of each line of the traverse has been deduced we are in a position to know the direction of the line that is, whether it is North or South and East or West. If the deduced bearing is between 0 degree and 90 degrees it is in the North East quadrant ; between 90 degrees and 180 degrees in the South East quadrant, between 180 degrees and 270 degrees in the South West quadrant and between 270 degrees and 360 degrees in the North West quadrant. This cardinal direction shows whether the latitude is North or South and the departure East or West.

It has already been explained that the latitude is the distance measured multiplied by the cosine of the deduced bearing and that the departure is the distance multiplied by the sine of the deduced bearing.

The calculations for the purpose of finding out the latitude and departure are made with reference to logarithmic tables which give the logarithms of the trigonometrical ratios only up to 90 degrees. For bearings, therefore, up to 90 degrees there is no difficulty in referring to the tables and calculating the latitude

and departure. But for bearings which are over 90 degrees we have to obtain their equivalents. The bearings are, therefore, reduced as follows :—

Between 0 degree and 90 degrees — no reduction is necessary
90 degrees and 180 degrees — subtract from 180 degrees
180 degrees and 270 degrees — subtract 180 degrees from it
270 degrees and 360 degrees — subtract from 360 degrees.

In other words, you find the angle which the traverse line forms with the meridian counted from the North or South towards the East or West.

The calculations for latitude and departure are then made with the aid of certain tables. When these are finished it can be found whether conditions 2 and 3 of a correct traverse are fulfilled. Small differences, if any, will be adjusted so as to make the northings and the southings and the eastings and westings equal.

Traverse Computation.

The working is done in a traverse computation form which exhibits at one view the result of the several operations in working a set of traverses—for proof of the boundary, plotting and computation of the area. (*See* Appendix I.)

The form is distinctly divisible into two parts, columns 1 to 13 which are only preparatory and form the ground work upon which the results obtained for the practical application of the traverse depend ; the remaining columns embody the results obtained.

The only data available are the bearing of the first line of the traverse, the included angles at all the stations of the traverse and the recorded distances. The elaborate form of the traverse computation sheet is prepared only from these three data.

The columns of the form explain themselves. Cols. 1 and 2 give the numbers of the station and the observed angles. The angles noted in column 2 are the observed inward angles at the stations indicated by the letters in col. 1. The total of the observed angles has been corrected to the extent shown in col. 3 so as to satisfy the first condition of a closed traverse. The observed bearing of the first line is noted in the form against the letter indicating the terminal point of the line. Thus the bearing of the line AB is noted against station B. Some note it against the starting station of the line. The bearing of the line BC is deduced in the manner explained above for deducing bearings and is noted against C, and so on for all the other stations.

The deduced bearings being known the cardinal directions of the several lines are readily ascertained. The bearing of station B being 281° 40′, it is in the fourth quadrant or in a N.W. direction. C the deduced bearing for which is 176° 5′ is in the second quadrant *i.e.*, S.E. The direction of the other lines is similarly entered.

For the purpose of computation, these bearings have to be 'reduced' as already explained and the 'reduced' bearings are noted in the computation sheet. This completes the preparatory work. We now require to compute the differences of latitude and departure.

COMPUTATION.

The reduced bearing of B being 78 degrees 20 minutes (Column 6) and the distance 12·38 the latitude and departure of B are calculated as follows :—

Latitude = Distance × Cos. Bearing

Latitude of B = 12·38 × Cos. 78° 20′

log latitude B = log 12·38 + log Cos. 78° 20′

log latitude B = log 12·38 + Log Cos. 78° 20′ — 10

= 1·092721 + 9·305819 — 10

= 0·398540

∴ Latitude B = 2·50346 Chains.

Similarly, the departure is found by multiplying the distance by the sine of the reduced bearing. The latitude and departure being known, whether they have to be entered as North or South or as East or West will have to be based on the entry of the cardinal direction. For B, the cardinal direction being N. W. the latitude found out should be entered in column 8 and the departure in column 14.

The latitudes and departures for all stations are then entered and totalled. Any slight errors in the total of northings and southings and total eastings and westings are adjusted by corrections in the largest lengths. The calculations so far enable us to know the difference in latitude and departure of station B with reference to A, of C with reference to B and so on. It has already been explained while referring to the different methods of plotting traverses that the best method and the one least liable to error is the one which enables each station of the traverse to be laid with reference to one station, the station of origin. The next step therefore is to find out the latitude and departure of each station with reference to station A.

See figure 5.

The latitude of B is A*b* north.

The latitude of C with reference to A is A*c* ; we have not calculated how much A*c* is ; but we know *bc* the latitude of C with reference to B and we know also A*b*. A*c* is only *bc* — A*b*.

The latitude of D with reference to A is A*d* = A*c* (which we have calculated) + *cd* (which we have entered in the form).

The latitude of E with reference to A is A*d* (calculated as above) minus *de* entered in the form.

The first distance (A*b*) goes north. The next *viz.*, b c goes south. The portion covered by the north A*b* is deducted and as the distance 'south' is greater, A*c* is south. We still go south to D, it is A*c* + *cd*. But, for E we come up some distance north. With reference to A, however, the distance south predominates. So the latitude of E with reference to A is A*d* — *de* and is south.

Similar principles apply in the case of the departures also.

The general rule is as follows :—

"When the distances run north of the first station add them one to the other until they change to south then deduct them one by one until the southing exceeds the northing, then deduct the latter from the former, changing the denomination to south ; all distances then going south are added and those going north deducted and so on, until arrived back at the starting station. Likewise in the distances on the perpendicular, when the distances run east of the meridian of the first station, add them one by one until they change to west, then deduct them until the westing exceeds the easting, then deduct the latter from the former, changing the denomination to west ; all distances then going west are added and those going east deducted and so on until arrived at the starting point" ; or, briefly,

"Take the sum or difference of the preceding latitude/departure in column 16/17 and the following latitude/departure in column $\frac{8}{12}$ for the following latitude/departure in column $\frac{16}{17}$; in the case of like symbols taking their sum and prefixing their symbol and in the case of unlike symbols, taking their difference and prefixing the symbol of the greater of them."

The figures for columns 16 and 17 are entered accordingly. The latitude and departure of each station with reference to the station of origin having been found out, we have obtained the data necessary for the method of plotting under the Gale's traverse system.

Plotting.

The latitude and departure of each station having been calculated with reference to the station of origin, in order to plot the survey fix upon some convenient point A on the paper for the station of origin. Draw through this a north and south line to represent its meridian and another east to west line perpendicular to it, N S and W E. Having determined the scale of plotting, to plot station B lay off along the meridian line from A north towards N A b according to the scale adopted 2·50 with a pair of compasses. On the perpendicular similarly lay off 12·12 west A b. Through b draw a line b B west parallel to W E and through b′ draw a line b B north parallel to N S ; thus the position of B is fixed. Join A B. Similarly the positions of the other stations are fixed.

Even this trouble in plotting can be minimised by squaring the paper or by the use of section paper which is paper ruled in squares of 1 inch sides. From the calculations we know the greatest northing of the plot as well as its greatest southing. The two added together determine the maximum length North to South to be plotted ; and from the scale adopted the size of sheet required can also be found. Similarly, with reference to the greatest easting and westing.

Add the greatest northing and the greatest southing. Deduct this from the total measurement of the sheet north to south. Leave half the difference as the margin on the north and the other half in the south. Similarly, add the greatest easting and the greatest westing. This sum deducted from the measurement of the paper

east and west gives the total margin to be left out. Half the difference is allowed as the margin in the east and the remaining half in the west. A rectangle is then constructed with the points so determined. The station of origin is then fixed with reference to the greatest northing or southing and the greatest easting or westing. The meridional and perpendicular lines are drawn through this point. Points are then marked on these lines at convenient and uniform distances. Parallel lines are drawn to these points and squares are thus formed. These squares enable the stations to be fixed easily and correctly.

The remaining columns of the computation form are for area. These columns are based on the principle on which the areas of fields surveyed with the chain and the cross staff are calculated mathematically. The surface is divided into trapezoids and right-angled triangles as you can easily see from the figure the traverse of which was set up. Some of the trapezoids and triangles are positive in which case their areas are additive while others are negative, *i.e.*, the areas are substractive. The products North and East and South and West are positive and the rest negative. (*N.B.*—In the N. E. quadrant Sin and Cos are positive, in the S. E. Sin (180 — A) is plus, Cos (180 — A) is minus; in the S. W. Sin (A — 180°) = — Sin A and Cos (A—180°) = — Cos. A ; in the N. W. Sin (360 — A) = — Sin A and Cos. (360° — A)=Cos. A. Hence N. E. and S. W. are positive and N. W. and S. E. are negative.

The area arrived at is the double area of the polygon. The correct area is therefore arrived at by dividing the result by two.

This gives only the area of the plot bounded by the traverse lines. The true boundary of the plot may be different. The correct area of the plot is therefore obtained by adding to or subtracting from the traverse area the area of the portions fixed by offsets which area is taken by means of the computing scale.

CHAPTER X—THE PRISMATIC COMPASS, PLANE TABLE AND CIRCUMFERENTER.

The other angular instruments are the Prismatic compass, the Plane Table and the circumferenter. The Plane Table does not measure angles but draws the angles on paper.

The Prismatic compass consists of a circular brass box with a magnetic needle which carries a ring the upper surface of which is graduated to degrees and generally sub-divided to half degrees also. The graduations are read through a prism. Over the prism is a slit which serves as the eye end and a sight vane is provided at the opposite end with a vertical wire in the middle by means of which intersections are made. The instrument is placed over a tripod stand but is also sometimes held in the hand. It reads the magnetic bearing of each line of the traverse.

No great reliance can be placed on the work done with the Prismatic compass as the local attraction of the iron in the neighbourhood neutralises the polar attraction. There is also an error inherent in the instrument known as the 'Variation

of the compass.' This variation is sometimes several degrees east or west of the true north. There are diurnal as well as annual variations. Owing to these defects the prismatic compass is not used for original traverses except occasionally for traversing minor circuits. But given a frame work more accurately determined and numerous known points by which the work can be checked, the compass may be made use of for laying down the topographical details such as roads, footpaths, buildings, etc. It is also useful for rapid and rough surveys. In the Madras Survey the use of the prismatic compass has been practically given up its place having been taken up by the circumferenter.

The Plane Table is an instrument for filling in the details of a survey when extreme accuracy is not required. The instrument should never be used for work where great accuracy is required.

The Plane Table consists of a drawing board mounted on a light tripod with which it can be clamped in position. The adjuncts of a plane table are the sight rule called alidade and a magnetic compass.

In using the table, if no fixed points have been determined beforehand, the first thing to do is to measure a base line. The plane table is placed over one end of the base line—the point on the table being above the point on the ground. The edge of the ruler is placed along the base line, and the table is turned until the sights come on to the other end of the base line in which position the table is clamped. This is called 'orienting' the table or 'setting' the table. The points of the field are then intersected by rays drawn from either end of the base line.

The advantage in using the Plane Table is that the surveyor plots off direct from nature the angles subtended at his eye by the various objects he may desire to lay down or work from. The method is expeditious and simple, the work is cheaply executed and the trouble often experienced in plotting from an assistant's badly kept field book is avoided. But the instrument should be used only for filling in the details in a skeleton plot with reference to accurately fixed points.

The circumferenter is used in the same manner as the Theodolite. The mechanism in some of the parts is the same in both. The most important difference between the two instruments is that the circumferenter reads only horizontal angles. The graduations are not so minute as in the Theodolite and the instrument itself is not to be used for survey work pretending to much accuracy. It is found very convenient for traversing minor circuits and other fields which are impossible for chain survey. It is a light and portable miniature theodolite.

CHAPTER XI—INSPECTION OF FIELD WORK.

Inspection of field measurement is done

(i) by re-measurement ; and

(ii) by the system of check measurement known as 'purtalling'.

Re-measurement is done by the simple process of verifying the measurements already made by rechaining the same lines.

Check measurement or 'purtalling' is the measurement across several fields of a long line with offsets by which the accuracy of some of the surveyor's measurements is verified. These 'purtal' lines also provide a series of bases for plotting the village map.

Purtal lines should, as a rule, start from and close on, Theodolite stations. The lines should be so selected that they may pass through a large number of fields and that the field bends to be offsetted may lie within easy distance from the lines. In exceptional cases, the 'purtal' measurement may start from a Theodolite Station or from a point on a line between two Theodolite Stations and close on another Theodolite Station or on a point in a line between two other Theodolite Stations.

The lines are drawn in the sketch and the chain and offset measurements are entered in it. From these chain and offset measurements the lengths of the sides forming the surveyor's 'F' lines and diagonals are calculated and the calculated distances verified with the recorded distances. The calculated distances should be entered in the sketch in red ink.

The margin of error allowable for original work is as follows:—In lines of 5 chains and under, 3 links; over 5 chains, one link per chain subject to a maximum of 10 links.

In the case of measurements on diagonal lines where, the cross staff has been used or in offset measurements, in lines of 5 chains and under, 4 links and in lines over 5 chains, one link per chain subject to a mxaimum of 10 links.

CHAPTER XII—MAPS—VILLAGE, TALUK AND DISTRICT.

A map is a representation of any part of the earth's surface drawn on paper on which all the lines or distances bear the same proportion to one another as those in nature do.

The particular kind of map required and the scale of the map will depend on the area of the survey, the purpose for which it is required, the degree of accuracy necessary, and on the minuteness or largeness of the individual parts of the object.

A good map is required by Government for administrative purposes and by the public for general use. In undeveloped countries a good map is essential for sound administration and organization.

Cadastral survey is primarily for the purposes of revenue. The unit for Revenue Administration is the village. The immediate needs of the Revenue Administration require a map drawn to a scale large enough to correctly delineate the land boundaries with a view to determining the areas of properties. Within the village the survey field is the unit adopted for measurement and mapping. The village map cannot obviously exhibit the measurements and at the same time be clear and distinct; nor can it exhibit the sub-divisions owing to their minuteness and liability to constant mutation. To exhibit these properly would require a

scale of 40 inches or 80 inches which would be a wholly unmanageable scale for village maps. The village maps therefore only show the survey units (survey fields) and are under the existing orders prepared on the 16 inch scale. The insertion of details even if it serves no other administrative purpose, is of great use to inspecting officers.

Taluk and District maps, on the other hand, are required for general administration and not primarily for the purpose of Revenue Administration alone. The boundaries of properties are not, therefore, necessary. The scale of the plan also need not be a large one ; and as the map covers a larger extent of country and as, for the purposes of administration, a better idea of its situation is required, the maps are plotted on as strict a geographical basis as possible.

Preparation.—The village and khandam boundaries are mapped with reference to the Traverse records. The field books prepared during the cadastral survey are thoroughly scrutinized and compared. With reference to the purtal inspection records, points are fixed for the plotting of the fields within the Khandam. The fields themselves are thereafter plotted. Errors noticed in the course of the plotting are checked and corrected. The details measured to are put in. Area computation of the individual fields and sub-divisions according to the field measurement book is made by means of two independent computations, a third computation being made where the difference between the 1st and 2nd computation is large. The areas of entire fields as plotted in the village map are taken by the computing scale and both sets of areas compared. The sum total of the areas of all the fields is compared with the traverse area from which it should not differ by more than 1 per cent. The village map is then finished and published.

Taluk Maps.—A rough key map is prepared with reference to the Atlas of India sheets showing the boundary of the Taluk and the meridians and parallels of latitude within which it is situated.

The manuscript map is prepared on a scale 2 inches to a mile. The values of all G. T. Stations and the village trijunctions within the boundary of the Taluk are computed. The trigonometrical stations and village trijunctions are plotted.

From the lithographed maps of the villages comprising the taluk, reductions are prepared by means of the pantagraph on scale 2 inches to a mile showing all details, except Theodolite stations and Khandam and field boundaries and numbers, ponds, wells and foot-paths. These pantagraph sketches are drawn on bank post paper. They are then transferred to the manuscript taluk map. The final map is reduced to scale 1 inch = 1 mile.

District maps are produced on lines similar to taluk maps—the original map is prepared on 1 inch = 2 miles scale and is finally reduced to 1 inch = 4 miles. Village boundaries are not shown, but pantagraph reductions of taluk boundaries are taken.

CHAPTER XIII—RESUMÉ.

We may now sum up the general outlines of a survey. The unit for survey is the revenue village. The first and essential preliminary operation is the demarcation of the boundaries of the village and of the khandams of from 150 to 200 acres in extent into which the village is divided. These boundaries are surveyed with Theodolite and chain, the survey is connected and harmonized with the G.T. stations of the Survey of India and traverses are set up and plotted to a scale 16″= 1 mile. The skeleton plots thus prepared are the framework on which the village map is built.

Next comes the demarcation of holdings in the village, khandam by khandam. When work within a khandam is started, a sketch thereof is prepared showing all the holdings in it and these are formed into compact groups—called survey fields—each containing about 10 acres in dry and 5 in wet. The included holdings (if more than one) in each survey field are mapped as sub-divisions. The points in the sketch where three or more survey fields meet are noted as trijunction points and demarcated. Other points which, according to existing orders, are similarly permanently demarcated are :—Theodolite stations, bends on poramboke survey fields and sub-divisions and on village boundaries and ends of diagonal lines not coincident with trijunction points. When the trijunctions have been demarcated, the lines forming the boundaries of fields and sub-divisions are measured. Diagonal lines are also measured between trijunction points so as to form a net work of triangles and the bends are offsetted. This provides a check on the correctness of the distances of the field and sub-division boundary lines. Field maps are then plotted. Purtal lines are measured between Theodolite stations on village and khandam boundaries and on these offsets are taken to field points within 5 chains distance. This provides a series of bases for plotting the survey fields in the skeleton of the village map referred to above. The surveyors prepare also a land register.

Note.—Minor circuits are not specifically referred to here. They are formed where necessary and demarcated.

Madras is the only province in which revenue surveys have been made as accurately as possible. In the other provinces the chief aim of revenue surveys was merely to determine the areas of revenue holdings approximately. In not one of them is there a complete record of field measurements, and in some there is none at all. In the Punjab the maps show the measurements of field boundaries but no interior measurements to fix them and in Bombay there is a field book containing a record of measurement but not to scale. In the United Provinces, Bengal, Orissa and Bihar there is no record of field measurement at all.

CHAPTER XIV—BRIEF HISTORY OF THE MADRAS CADASTRAL SURVEY.

ANCIENT SURVEY—PAIMASH.

The first Revenue Survey of which we possess any records is the 'Paimash' which was conducted in several districts of the Madras Presidency during the first quarter of the 19th century. In this survey each holding was numbered and its name, measurement from north to south and east to west, area and boundaries were recorded on cadjan leaves or on flimsy paper. The measurements were usually taken with a 24 feet chain and the areas were obtained by the Khasra method—multiplying the mean of the lengths by the mean of the breadths and were recorded in Cawnies, grounds or other similar local units. No attempt at mapping was made. These records are still available in most Collector's Offices and are occasionally referred to. The indigenous mind is apt to attach undue importance to them merely because they are old. It is however usually impossible to identify on the ground the field referred to. It is doubtful what unit of measurement was adopted, the English foot or the Indian foot of ten inches. The method of area calculation gives wrong results unless the field is rectangular. Moreover the cadjan records are easily forged and even if genuine they have no value as legal evidence of boundaries as they have been superseded almost everywhere by modern surveys conducted under a Survey Act. A specimen copy of the entry in a Paimash Register is appended. (Appendix II.)

MODERN REVENUE SURVEYS—ORIGINAL SURVEY.

The Madras Survey Department with a Superintendent and the required establishment was sanctioned and commenced work in 1858. The Cadastral survey of the ryotwari area of the Presidency was completed by 1896. Much of this area has since been resurveyed or revised.

The Settlement Department at first undertook to demarcate village and field boundaries and did it up to 1864. This was a tedious process involving much arbitration and investigation of many disputes which were fostered by years of factious contention. This unsatisfactory work occupied much time and attention and so was transferred to the Survey Department itself.

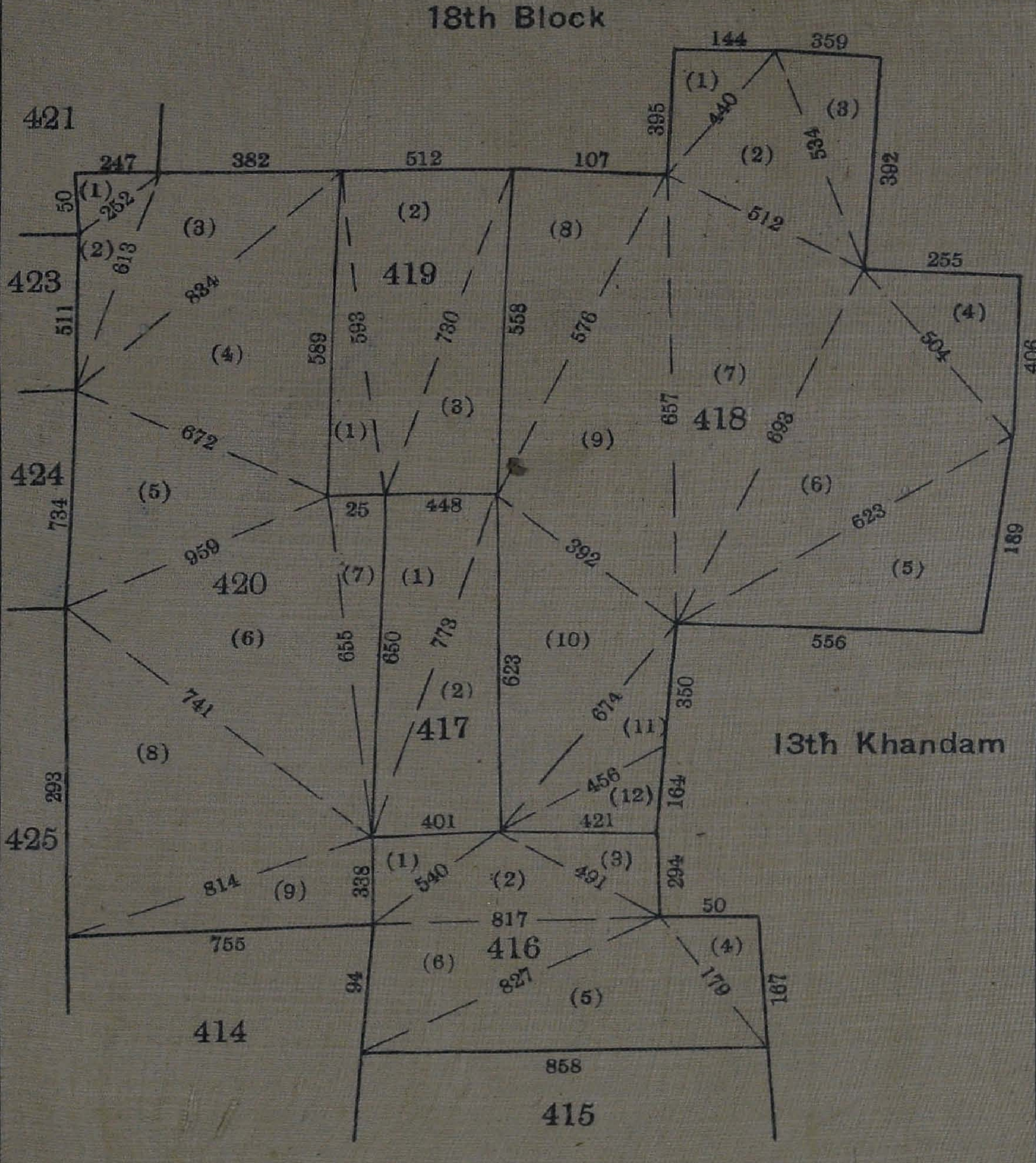
The cultivated portions of each village were divided into Khandams of about 50 acres each. In 1866 when the Survey Dpeartment undertook the demarcation the average size of Khandams was raised from 50 to 80 acres at first and afterwards to between 100 and 150 acres.

As regards *fields*, from the first it was decided to form survey fields of convenient sizes by clubbing or dividing ryots' holdings (G. O. No. 951/Rev. dated 14-8-1855). The survey no doubt proceeded on the basis of occupation but it was ruled that the minute sub-divisions prevailing in many villages should not be separately surveyed but that a number of them might be clubbed into one field so as to form a convenient plot. The survey was started with standard fields of two acres

Fig. 7

Extract from the Amin's Field Book.

District Madura
Taluk Palni
Village Do
14th Khandam 2nd Part



in wet and four in dry. But in 1868 during the survey of the Chicacole Taluk in the Ganjam District the process of clubbing revenue fields to form survey fields was temporarily and wholly suspended and the same principle with some modification was adopted in the other two taluks of the district. Every field, large or small, was surveyed as it stood with the result that in almost every village fields of 1, 2 or 3 cents were recognised. Even now the average size of a survey field in Ganjam is only 1·3 acres which is smaller than in any other district. The result of such survey was excessive demarcation and slow progress. In 1887 the maximum size of survey fields was fixed at 6 acres in wet and 12 acres in dry but as the enforcement of the rule led to the formation of survey fields containing as in Malabar an inconveniently large number of holdings, the number of holdings to be clubbed was limited in 1894 to 10. The latest rule lays down a limit of 5 acres in wet and 10 in dry and not more than 20 sub-divisions unless the field is less than 2 acres in wet or 4 in dry in which case there is no limit to the number of sub-divisions. So much as regards the demarcation and the size of survey fields.

Method of Survey.

This process, as you know, comprises two principal operations—Theodolite Survey and Cadastral Survey.

Originally, the villages of a Taluk were grouped into convenient blocks, called main circuits varying from 100 to 150 square miles in extent. These were surveyed with the Theodolite and then the village and Khandam boundaries. The main circuits were connected with the G. T. Stations. Up to 1877 the Cadastral distances were merely compared with the G. T. Survey distances and the differences were noted without any attempt at correction. From 1878 to 1891 the Theodolite work started from a G. T. Station in the vicinity of the tract surveyed and closed on another and the Cadastral survey latitudes and departures were corrected. For surveys after 1892 the Theodolite Survey of Khandams was dispensed with as being too costly. Main circuits only were measured by which a few Theodolite stations were fixed in each village and the villages were divided into triangles with sides of half a mile long and the three angles of each triangle were measured and also some base lines. The distances were computed. As this survey though economical was not sufficient for an accurate survey of the fields in a manner suitable for future maintenance, village and Khandam traverses have been since restored.

Field Survey.

The method of measurement of individual properties and holdings underwent several changes as the survey progressed. The several stages may be roughly classed as below :—

Original Survey.

I.	The Khasra method	1858—1865
II.	Triangles	1866—1877

III.	Triangles coupled with offsets when bends were numerous	1878—1886
IV.	Plane Table system	1887—1891
V.	40″ Block map	1892—1896

I. The Khasra Method.

The Khasra method was adopted from the Indians. According to this method, if the field was quadrilateral the four sides were measured and all irregular fields were divided into quadrilateral or triangular portions, called 'taks' and the field itself could be plotted only by piecing together these *taks*. There was a rule that the diagonal of every quadrilateral should be measured but this was not always done. Measurement sketches—not to scale—were prepared in some cases but these were subsequently destroyed. Village maps were prepared on a traverse basis.

The 'Khasra' regards all quadrilaterals as rectangular figures and the four sides being measured the area is taken to be the product of the mean lengths of the opposite sides. For triangles a similar fiction is maintained and the area is calculated at half the product of the two shorter sides.

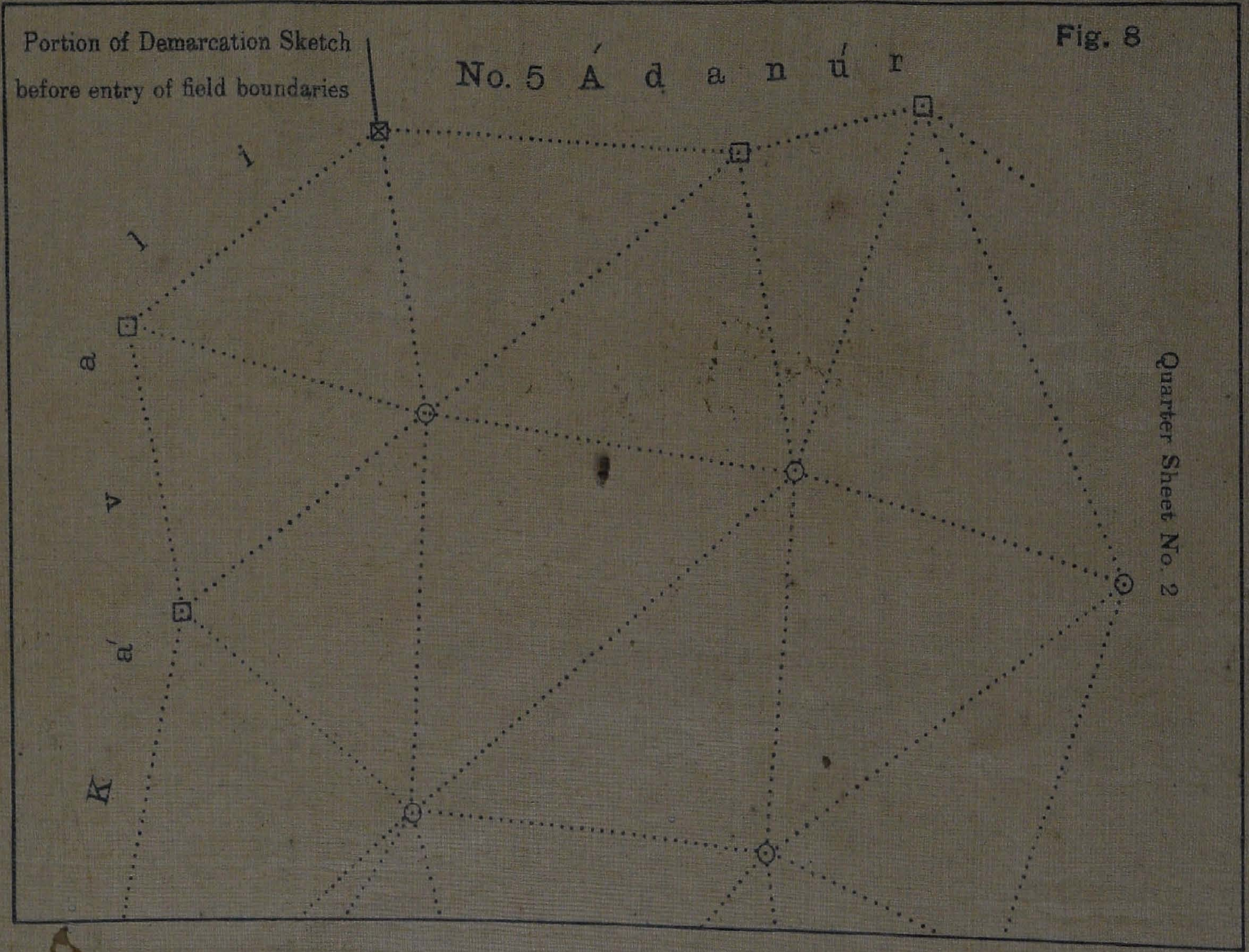
All areas surveyed under the above method have since been resurveyed. [To prove the inaccuracy of Khasra, take four matches all of which are equal in length. Form different shapes with these four matches and note what varying results of size and area you get.]

II. Triangles Method, 1866—1877.

The Khasra method being inaccurate in all respects the field surveyors were in 1866 directed to measure from stone to stone so as to divide each field into traingles as nearly equilateral as the shape of the field would allow. In the early period of the introduction of this method and during the transition, diagonals were in some cases (*e.g.*, some taluks of Coimbatore) omitted. In other cases, the field was divided into 'taks' as under the Khasra method and the 'taks' were again divided into triangles. The 'tak' system which converted each field into a series of 'mosaics' died hard and measurements were taken, not from stone to stone, but from corner to corner of the 'tak'. Sometimes a point inside the field was taken and lines measured from it to all corners but this amendment was also dropped and the system of triangles based on lines from stone to stone of the field was eventually adopted. (*See* Figure 7.)

As regards the record of such survey, it also underwent a great change during the period. The older books contained the measurement of the four sides and the diagonal of each 'tak' the sides being given as north, south, east and west and the diagonal being shown in a parallel column. Where the 'tak' was a triangle, the side represented by the apex was shown as zero. Sometimes a rough sketch of the field showing the relative positions of the 'taks' was entered in the margin. (*See* Figure 7*a*).

Fig. 8



Portion of Demarcation Sketch before entry of field boundaries

No. of field & commencement of measurement	Sides of fields		Shape and diagonal	Contents	
	North & South	East & West		Acres.	Decimals.
46	N 268	W 254	276 387		
S W of 45	S 323	E 97		1	84
46+1	N 323	E 250	359		
S E of 46	S 268	W 83	296		
46+2	S 0	W 93			
S E of 46+1	N 72	E 30			
46+3	E 268	E 306	418 417		
S W of 46+2	W 302	W 317			
46+4	S 0	W 58			
S E of 46+3	N 36	E 23			

Fig. 7a

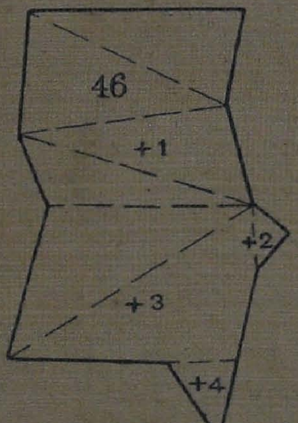
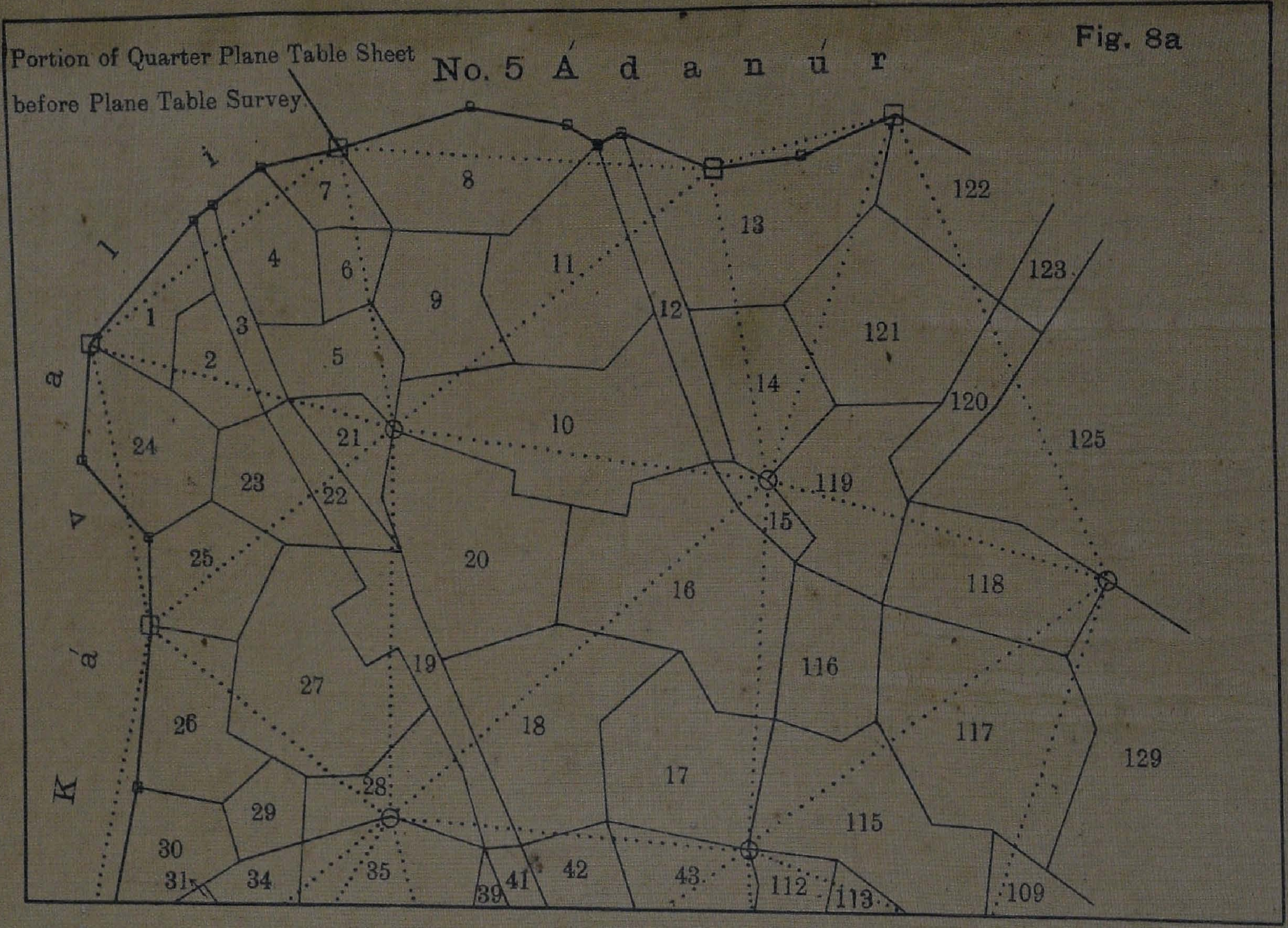


Fig. 8a



Portion of Quarter Plane Table Sheet
before Plane Table Survey
No. 5 Áḍanúr
Kávali
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
34
35
39
41
42
43
109
112
113
115
116
117
118
119
120
121
122
123
125
129

Portion of Quarter Plane Table Sheet after Plane Table Survey.

No. 5 Ádanúr

Fig. 8b

As soon as the triangles system was fully established, an eye sketch of each field showing all measurements was prepared. Sometimes the sketch book shows several fields on one page. These sketches are known as the Amin sketches so named because the surveyor was called the Amin.

Area was taken with the computing scale from the 16″ village map, the computing scale having been introduced in 1864. The village map was prepared on a traverse basis.

III. *Triangles with Offsets, 1878—1886.*

In or about 1877 surveyors were allowed, when bends on the field boundaries were numerous, to fix by offsets the positions of all marks less than 50 links from a direct line between adjoining survey stones. The change was a salutary one for the old system of chaining between field stones had caused a great deal of unnecessary labour. Very little advantage, however, was taken in practice of this system of measuring offsets.

IV. *Plane Table, 1887—1892.*

In 1887 in consequence of a note by the Finance Committee on the revision of the provinicial contract, a Survey and Settlement Committee sat in Madras to consider how survey work could be expedited and several radical changes were made in the methods of Survey. The chief reforms sanctioned were the introduction of the Plane Table system of Survey and the concentration of the various processes of both Settlement and Survey work. Field demarcation was reduced in quantity by raising the maximum areas of survey fields to 6 acres in wet and 12 in dry and the measurement of sub-divisions which was till then done by the Settlement Deparment was transferred to the Survey Department.

The plane table survey was introduced in order to reduce the cost of survey It is paradoxical but true that in the so called plane table survey the plane table was not used. The Theodolite stations were pricked off from the plotted skeleton map into a quarter sheet so named because it was intended to show an area of about ¼ square mile. In this quarter sheet the surveyor sketched in the field boundaries which were not, therefore, to scale. The quarter sheet was practically the demarcation sketch. The sides of the triangles formed by the Theodolite stations were chained and offsets taken to all field marks. The chain line and offset measurements were entered in the quarter sheet. (*See* Figures 8, 8*a* and 8*b*). The outer boundaries of fields were also measured but the measurements were not entered in the quarter sheet. A separate record known as the interstitial or sub-division field book was prepared in which were shown the measurements of the outer boundaries of survey fields and sub-divisions and of the quadrilaterals and triangles into which the latter had been divided. Although in the matter of sub-divisions there was thus a reversion to the old Khasra method, the system was sufficiently scientific for plotting the village map.

V.—Block Map System, 1892—1896.

From 1892 heodolite frame work was reduced as already described. This change combined with the plane table method of survey produced the 'Block map' method. The theodolite stations were plotted on scale 1″=2 chains or 40 inches = 1 mile on sheets containing ¼ square mile. The block was divided into large triangles and all survey fields and sub-divisions were correctly *plotted* by offsets from the sides of these triangles. The areas of the fields were then taken with the area square. The village map was formed by superimposing reductions of the block maps on the traverse skeletons.

Only a few of the apices of these triangles were Theodolite stations, the rest being field stones or even peg stations. This method was extremely cheap but the results were inaccurate and the system unsuited for maintenance. (*See* B. P. No. 321/R. S., dated 12–10–1905 for the defects of this system.) The survey field being regarded in this Presidency as the unit of survey and arrangements for maintenance being made with this view, the village map need only show the boundaries of survey fields. But the village maps of the areas surveyed under the Block map system show not only survey field boundaries but also the boundaries of sub-divisions as they existed at the time of survey. As these sub-divisions are constantly undergoing change, there will in the course of a few years be very little agreement between the sub-divisions shown in the block map and the actual state of things on the ground.

Resurveys.

About the year 1890 it was found that in some of the districts first surveyed the demarcation of the fields was not of a permanent character and in others a large percentage of them had disappeared. The sketches of interstitial fields made by the Settlement Department were generally not forthcoming and in the few instances in which they did exist it was not found practicable to incorporate them into the field measurement books prepared by the Survey Department. No attempt had been made to keep the survey up to date and the records originally prepared were out of print and out of date. For these reasons a Resurvey was ordered. This was at a time when the Block map system was under consideration for initial surveys. The same system was, therefore, followed in the districts first resurveyed such as Trichinopoly and parts of Kistna and Godavari. The old survey numbering was ignored and new fields with new numbers were formed at Resurvey which thus became to all intents and purposes a second initial survey.

The second period of resurveys began in 1893 in Salem. As in Trichinopoly the redemarcation followed occupation, but with a view to reduce the cost of work no alterations were made either in the original size or numbering of the fields. Distances from stone to stone on the field boundary and from bend to bend on the sub-division boundaries were measured as also the sides of the triangles. Bends on field and sub-division boundaries were fixed by offsets measured from the sides of

the triangles. A field measurement book showing the resurvey boundaries of the fields was plotted to scale but not the village map. In a lithographed copy of the original survey map the scale of which was 16 inches to a mile the field boundaries which might differ slightly from the demarcated boundaries shown in the Field Measurement Book were inked and a photo reduction of this copy to the 8 inch scale served as a key to the position and shape of the survey fields. (*e.g.* Godavari Dt.—Peddapuram and Rajahmundry, Guntur Dt.—Tenali).

Even during the second stage of resurvey, the obsession of economy persisted with the result that accuracy was sacrificed to cheapness. No village maps were plotted and the Theodolite stations were not verified. This resurvey also proved a failure. The full modern system with a replotted village map was first used in Nellore and the northern taluks of Salem.

Revision Surveys.

When in 1902 maintenance on modern lines was taken up, the first essential was a complete field measurement book. In some cases this had already been prepared in the course of resurvey. In other cases, it was prepared by karnams from the old Amin sketches and Settlement 'shape' books supplemented by such further measurement in the fields as was found necessary. Where it was obvious or was subsequently found by experience, that the work was beyond the capacity of the karnam it was undertaken by the Survey Department. This was called a Revision Survey. In addition to preparing complete field measurement books, the opportunity was taken to revise the revenue registry, to replace all missing stones and to issue new village maps by tracing from the old maps and incorporating all changes. A certain amount of resurvey was done in the case of railways, irrigation works, etc.

Where the original records, therefore, afforded sufficient material for replacing missing stones and plotting separate maps of survey fields and the work to be newly done consisted mainly in measuring and mapping sub-divisions effected since the original survey the process was called a revision survey.

Where the original records contained no sufficient material for replacing missing stones and plotting separate maps of survey fields and the work of measuring and plotting the fields had to be done in addition to measuring and mapping sub-divisions effected since the original survey, the process was called a Resurvey.

It is obvious that a tract dealt with under the Khasra method had necessarily to be resurveyed. In other cases, it depended upon the state of the record whether the tract was to be resurveyed or revision surveyed.

Where the records of the Plane Table and Block map areas were either imperfect or incorrect, a resurvey had necessarily to be undertaken. But in the case of the areas originally dealt with under the 'triangles' system it was expected that the survey records would afford sufficient material for plotting field sketches

and that the work would consist mainly in replacing missing stones and measuring and mapping sub-divisions effected since the original survey. Such tracts were put down for Revision Survey.

Revision Survey and Resurveys.

Experience however, showed that the resurvey method was superior. In a resurvey all the fields are remeasured and a new village map is prepared. In a revision survey only a portion of the tract is surveyed owing to defects in the original record or in connection with the replacement of missing stones, or measurement of sub-divisions. Though a part of the area alone had to be remeasured, the work involved in measuring that part was more intricate than the work involved in a resurvey. Some fields had to be surveyed afresh on the 'diagonal and offset' system while the demarcation of the other fields continued on the triangles system. The survey was thus divergent as well as inconsistent. The errors in the fields not dealt with at the time of the revision survey were perpetuated. Further, the village map prepared in the course of a revision survey was practically a tracing from the original map and was not as accurate as a map prepared in the course of a resurvey. The most important and fundamental objection was that a revision survey was only an attempt to reproduce a record of the conditions of several years ago while a resurvey was the record of the conditions obtaining on the ground at the time of the survey (Bhusthithi). Whenever professional survey operations are undertaken the facts on the ground should be the survey officer's chief guide. This serious defect in the Revision Survey led to the formation of several fictitious sub-divisions due to altered boundaries, so much so that changes had to be proposed in the working of the rules the effect of which was to approximate revision survey very closely to the form of resurvey. The clubbing of fields and simplification of demarcation were incompatible with the system of revision survey and it was also unfavourable to easy maintenance.

The question, therefore, arose whether it would not be better to abolish altogether the distinction between a resurvey and a revision survey and to adopt the resurvey methods alone in future surveys. The objection to the latter method was only slightly increased cost. It was pointed out that resurvey cost Rs. 300 per square mile and revision survey Rs. 250. Revision survey was done comparatively more rapidly. But there was increase in accuracy and consistency by the adoption of resurvey methods. The Government accordingly agreed with the Survey and Land Records Committee and the Board of Revenue that resurvey methods alone should be adopted in all future surveys.

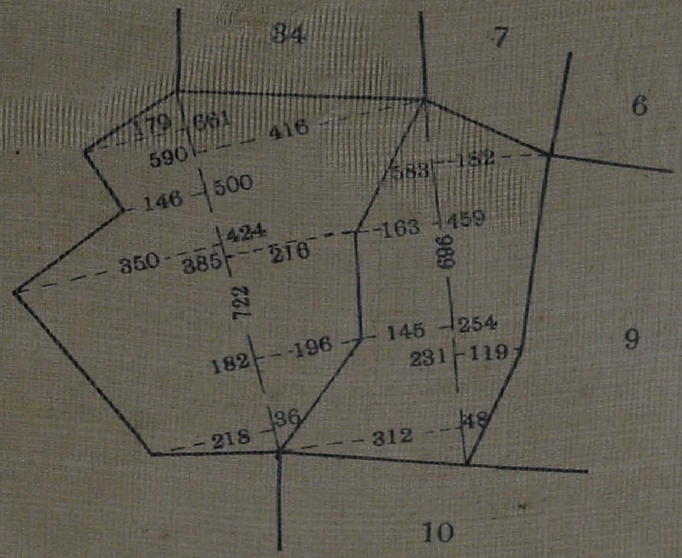
G.O. No. 773/Rev., dated 4th April 1916—B. P. No. 103 dated 28-4-1916. (Para 33, Survey and Land Records Committee's report).

Merits and Demerits of the Different Systems of Survey.

In considering the merits and demerits of the different methods of survey we have to consider the question not only from the point of view of the intrinsic merit

32

Fig. 9



Vandyke Survey Office, Madras. 1931.

and accuracy of each method but also from the point of view of how far each method conduces to efficient maintenance. For any system, the following criteria may be applied, (1) accuracy, (2) speed, (3) cost and (4) possibility of maintenance.

The paimash and the khasra methods have to be rejected absolutely not only because the system itself is mathematically inaccurate but also because it is impossible of maintenance. The block map, the triangles and the diagonal and offset systems alone have to be considered. The block map system has proved inaccurate. Each field point is fixed by means of offsets taken from external base lines. The measurement of such long lines is no easy task especially when the country is undulating or covered with prickly pear or hedges. The offsets taken are sometimes inconveniently long. Strict accuracy of measurement becomes, therefore, a matter of difficulty and this must be particularly so where Karnams are employed as surveyors. The village map has to be prepared by piecing together the 40 inch block maps reduced by photography to the 16″ scale. There is no separate field measurement book. Karnams have, however, been supplied with field maps traced from the block maps which show only the exterior boundaries. The 'one page to each field' map which is essential for maintenance is impossible under the block map system. In the matter of maintenance, when missing stones have to be replaced the long lines in the block map have to be laid out on the ground with the chain and cross staff which process must necessarily take a long time and demands great care. The difficulty of laying out the line correctly is insurmountable when the country is undulating or the line is obstructed by houses, hedges, etc. The Karnam who is the basis of maintenance cannot certainly do it. Unless maintenance is made easy, efficient and accurate the only alternative is expensive periodical resurveys. This system is, therefore, radically unsuitable as a basis for keeping a record of measurements up to date.

The triangles system is correct in its method. But it involves more measurements than any other system and necessitates the maintenance of stones at every bend of the field. There are possibilities of errors in the measurement as there is no check and countercheck in the method of survey itself. There is the possibility of the plotting and the shape of the fields becoming distorted as the cadastral survey frame work is based on a number of ill-conditioned triangles plotted one over the other in order to produce the field map. Restriction of demarcation to the limit absolutely necessary not being possible under this system the task of maintenance will be heavy. The process of relaying a missing stone is itself more complicated than under the diagonal and offset system. The number of stones being kept at a high figure the karnam's task of inspection will be unduly severe and one which he cannot properly fulfil.

The diagonal and offset system strictly followed, is by far the best among all the systems not only as regards the accuracy of the survey itself but also as regards the feasibility of maintenance. The system facilitates restriction of demarcation to trijunction points. The frame work of the survey can thus be easily maintained.

The following special systems of survey were adopted in certain special localities.

Kallikota and Atagada.—As the name itself suggests this system of survey was adopted in Kallikota, Atagada and Dharakota estates in the years 1912-1917. This is only a modification of the plane table system. Each holding became a survey field. Lines were run between theodolite stations and offsets taken to all field bends. Field boundaries were not measured. Measurements were recorded in Khandam sketches and in field books.

Theodolite, Prismatic Compass and Plane Table.—This was done in the Nilgiris district and in the Malabar Wynaad, chiefly with the theodolite and chain supplemented with the plane table and prismatic compass.

PUNGANUR SYSTEM.

This is a modified form of the diagonal and offset system of survey. The essential feature of the system is that all points on the boundary of a field are offsetted from one G. line. (See figure 9).

This system, as its name indicates, was first adopted in the Punganur Zamindari. It was followed in Tiruvannamalai and Repalli taluks and also in the Venkatagiri Zamindari.

This method of survey was casually considered by the Survey and Land Record Committee, a special committee considered the system in 1916 and a conference of Survey Officers in 1918. The system has since been abandoned—B. P. 139 R. S. dated 26th November 1920.

The field boundaries are not measured under this system but computed. As the same points are offsetted from two fields, there is a check on the accuracy of the work. Long offsets proved the most difficult problem under this system. Various expedients were, therefore, adopted in order to overcome this difficulty. Two or more G lines were measured and whenever the offset exceeded 5 chains, inspecting officers were instructed actually to measure the F lines in order to check the accuracy of the work. The limits up to which holdings might be clubbed were fixed as 4 acres in wet and 8 in dry so as to avoid the necessity of having to measure long offsets. The measurement of sub-divisions also proved a matter of difficulty. The sub-division bends were ordered to be offsetted. When the sub-division points fell in F lines, the part distances had actually to be measured. Such of the sub-division lines as could not be computed had also to be measured. (It should be noted that there was no outside check over the accuracy of the computed sub-division distances).

The advantages claimed for this system were saving in linear measurements and consequently in cost, accuracy and speed. But it had to be admitted that the demarcation of all bends with stone was necessary because otherwise the progress of survey and inspection would be heavily handicapped though it was suggested that after such survey the bend stones need not be maintained.

The Board however held that the saving in cost depended on saving in (1) measurement, (2) time spent and (3) establishment required. As regards (1) as each bend had to be offsetted twice or as many times as there are fields meeting at a bend and as both field and sub-division lines had actually to be measured in certain cases, the so called saving in measurement could not be very appreciable. As regards time, under the diagonal and offset system mere mechanical measurement of chaining with taking offsets in a few cases is all that is required. Under the Punganur system the cross staff has to be used very often, setting it in position, offsetting the bends as many times as there are fields meeting at a bend and computing the F lines as often. As regards establishment it was considered that under the diagonal and offset system the field staff had to be large and the office staff small. Under the Punganur system although some surveyors sufficed, they were required to be able enough to handle the cross staff well, while a larger staff of a better class of computers was required in the office.

The system is further unfit except in plain country. The modification to offset sub-division points falling on F lines involved a lot of extra measuring. This method of measuring sub-divisions during maintenance would be impossible by the Karnam and the Firka Revenue Inspector. Plotting of field maps is easier under the Punganur system but plotting of village maps involves large calculations and is more tedious. There is no saving in demarcation and in respect of maintenance the karnam who would be tempted to use the cross-staff for replacing missing stones instead of calculating and taking the field measurement is very likely to commit mistakes in work with the cross staff.

There being no outstanding advantage in any respect the system has been abandoned.

CHAPTER XV—SPECIAL SURVEYS.

Mamul wet survey—Object.—The object of the survey is to determine, localize and demarcate all mamul wet lands or lands entitled to free irrigation, whether for a single or for a double crop, from Government sources of irrigation in Inam and Zamindari tracts.

The necessity for such a survey arose when, owing to the introduction of large irrigation projects, considerable areas which had till then remained waste or were fit only for dry cultivation, were brought under wet cultivation. In order to levy water rate it became necessary to ascertain the extent entitled to free irrigation so that water rate might be charged on the extent irrigated over and above it.

Processes.—The different processes involved in the survey are :—

(1) the determination of the areas entitled to free irrigation. This is done with reference to title deeds, sanads, Inam Registers and after enquiry of the village officers and the proprietors and their agents ;

(2) the localization and demarcation of the areas so determined ;

(3) the measurement and mapping of the demarcated fields ; and

(4) the final adjustment of the areas.

The determination of the areas entitled to free irrigation and their localization form the most important task of the special establishment and require careful investigation with reference to the old accounts. These are purely executive matters. A statement of the extent as ascertained by the Special Officer has to be submitted to the Collector and orders obtained from him before the further process can be taken up. The Board has power to revise, either on application or of its own motion, any orders passed by the Collector. The final adjustment of areas is also an executive matter in which orders have to be passed by the Collector. The other operations are done under the Survey Act.

Staff.—All mamul wet surveys are done by a special establishment consisting of a Special Deputy Tahsildar, Special Revenue Inspectors, a Clerk and Peons.

Nature of Survey.—The demarcation, measurement and mapping and the inspection of the work are done in accordance with the Rules 7 to 20 of the rules appended to B. P. 178/R. S., dated 21-6-1915.

(1) In addition to demarcating and measuring the mamul wet portion, a detailed survey has to be made of lands outside the already fixed wet zone which are at present irrigated or, are likely to be irrigated in future in years of good supply.

(2) The blocks and fields surveyed should be connected with one another and with the village boundary by means of a traverse or by tie lines, as the case may be. Unless this is done, it would be impossible to prepare key maps.

(3) Incidentally, fields interspersed in the midst of mamul wet lands, such as channels and roads, have to be surveyed in order to produce a proper combined key map.

(4) Field Measurement Books and block maps have to be prepared in triplicate—one copy for the Collectors' Office, another for the Karnam and the third for the Taluk Office for maintenance.

(5) Key maps on the 16″ scale are printed and supplied to the Collector, Divisional Officer, Taluk Office and Karnam.

(6) The special staff is also responsible for numbering the stones in the key maps and preparing the stone registers—(B. P. No. 3220/Mis. Rev., dated 12-12-1916).

Maintenance.—The maintenance of this survey is attended to by Government agency and at the cost of the Government.

Town Survey.

Object.—The objects of a town survey and its maintenance are :—

(1) to provide an accurate record of lands paying revenue to Government and of Government waste and poramboke lands ;

(2) to provide the Municipal authorities with an accurate basis for the assessment of the Municipal taxation, with an accurate record of all Municipal lands, and with an accurate set of maps for general Municipal administration ; and

(3) to have a correct record for checking encroachments and defining the limits of public and private property.

The rules for Town Survey are contained in B. P. 83/R. S., dated 15-6-1920, *see* also B. P. 79, dated 11-6-1921 and B. P. 130, dated 25-8-1921.

Survey.—Detailed rules for the conduct of Town Surveys are contained in B. P. 83/R. S., dated 15-6-1920. The town is divided into wards and the wards into blocks. All these are surveyed by means of the Theodolite—the existing Theodolite work of the villages included in the town being utilised. For the detailed survey of the properties chain survey stations are fixed in a line between two Theodolite Stations or, are connected with the Theodolite work by means of a traverse with the circumferentor. The individual properties are demarcated by stones in open blocks but these are dispensed with wherever there are masonry walls.

Town maps, ward maps, Revenue maps (both as bound volumes and loose sheets) and the Record of Measurements are prepared. The measurements are taken with a feet chain and the areas are in square feet.

Maintenance is attended to so far as lands paying assessment to Government, minor inams, unoccupied assessed land and Government poramboke or unassessed land not vested in the Municipality are concerned, by the Karnam and so far as other descriptions of land are concerned by the Town Surveyor.

G. O. 2088, Rev., dated 31-10-1930 contains the rules for the maintenance of Town Survey.

STREET SURVEY.

This is generally confined to streets within a Union which does not desire a regular town survey. The records prepared are a map of the Union (scale 1" = 1 mile) showing the streets but no house details and an atlas of street field maps showing measurements.

SOIL BLOCK SURVEY.

For the purpose of determining the land cess, a block survey of whole Inam villages was made in the districts of Godavari, Kistna, etc. The villages were divided by settlement classifiers into blocks according to peculiarities of soil and demarcated with pegs or earthen mounds. The blocks were measured and mapped by the Survey Department.

ESTATE SURVEY.

'Estate' means any permanently settled estate or a separately registered portion thereof, any Inam village or any portion consisting of one or more villages held on a permanent under tenure.

Estates are surveyed under Section 17 of Act VIII of 1923 either on the application of the proprietors or without application. The cost is borne by the proprietor or Government but not by the tenants who pay only for the cost of stone and labour

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if the apportionment is made by Government on application made by the proprietor. Such surveys are maintained as provided in Section 21 of the Act. For rules, *see* B.P. 11 Press, dated 13-3-1926.

Maintenance in estates is mostly confined to maintenance of survey marks, and does not involve the maintenance of records as in Government villages. Maintenance is undertaken only if desired by the proprietors or by the tenants. The power to enforce the liability of the tenants to maintain the survey marks under Section 21 is vested only in the Collector. The work has, therefore, to be done by Government agency. In most cases special establishment will be necessary. For the procedure to be followed in the maintenance of surveys in estates, *see* B.S.O. 34 C.

CHAPTER XVI—LAW RELATING TO SURVEYS.

The legal provisions under which survey work is conducted are contained in Madras Act VIII of 1923. Its immediate predecessor was Madras Act IV of 1897. There are several areas in the Presidency which were surveyed under the provisions of the latter Act. The most important difference between Act IV of 1897 and Act VIII of 1923 is that the record of the survey under the latter is conclusive proof that the boundaries determined and recorded have been correctly determined and recorded—whether there have been disputes or not—unless modified by a decree of a civil court on a suit instituted within three years from the date of the publication of the notification regarding the completion of the survey.

The legal rules under the Act are published in B. P. 11 Press, dated 13-3-1926.

Any survey operation to be legally valid should be carried out under the provisions of the Act and the various notices and notifications prescribed by the Act and the rules should be served and published in the manner prescribed. The object in observing these formalities is (1) to legalise the recovery of the cost of survey, (2) to legalise the boundaries determined and (3) to enforce the maintenance of the survey where necessary. The officers competent to exercise the powers given by the Act are declared as 'Survey Officers' under Section 4. All Revenue Inspectors, Tahsildars, Dy. Tahsildars, R.D.Os., Deputy Surveyors and Town and Union Surveyors have been declared as "survey officers" within their respective jurisdictions. Officers specially appointed for special works—*e.g.*, land acquisition, will have to be formally notified as "Survey Officers."

Before a survey is commenced a notification under Section 5 in the case of Government lands and under Section 17 (*a*) or 17 (*b*) in the case of estate land should be issued. The Board is empowered to issue the notifications under Sections 5 and 17 (*a*) if the administrative approval of the Government to the survey has been obtained. In the case of survey of estates under Section 17 (*b*) the notification should be issued by the Government themselves as they have to decide in each case that the survey is necessary.

The Board has by a general notification directed the survey under the Act of

(1) all sub-divisions affecting poramboke boundaries now registered or hereafter to be registered in the village accounts or Town survey registers,

(2) all new fields formed out of existing survey fields,

(3) survey of sub-divisions separating occupied from unoccupied dry lands in Malabar,

(4) all supplemental sub-divisions created subsequent to the survey which fall under one or other of the three classes described below :—

  (1) sub-divisions necessitated by order on appeal under Section 12 (1) of the Survey and Boundaries Act (IV of 1897).

  (2) sub-divisions ordered on enquiry into objections on settlement rough pattas,

  (3) sub-divisions found necessary as a result of the check of survey records or otherwise.

(B.P. 259, dated 26–9–1917 and 233, dated 31–8–1915).

Items 1, 2 and 3 are incidental to maintenance and item 4 to original and re-surveys. Ordinarily, therefore, Section 5 notification will be necessary only for new surveys of unsurveyed blocks of government land and resurveys of tracts already surveyed. The notification should be published in the District and Fort St. George Gazettes.

The notification under Section 6, or in the case of an estate, under this section read with Section 18 is issued by the survey officer appointed under Section 4. Where the survey relates to one or more villages it should be published in two successive issues of the village sheet of the District Gazette and should be affixed to the village chavadi or, where there is no chavadi, in some other conspicuous place in the village. Where the survey relates to part only of a village the notification should contain particulars of the fields to be surveyed and publication in the village chavadi is sufficient. In both cases the fact of publication should by announced by beat of tom tom in the village.

The next notice is under Section 8 relating to the cost of the survey to be recovered. The Tahsildar should prepare a demand notice in duplicate under Section 8 showing the fields held by each person according to the latest village accounts and the charges recoverable for the survey thereof. This is sent to the village headman who posts a copy in the village chavadi and leaves the other with the registered holder or other person interested in the fields. Acknowledgments in token of the receipt of the notice should be obtained in a book maintained for the purpose. There is a right of appeal against this demand.

For legalising the survey, notices are issued under Section 9 (2) or 10 (2) the former when there is no dispute and the latter when there is dispute. The notice under Section 9 (2) should be in the form of an extract from the field register relating to the holding and should state the time within which, and the officer to

whom, appeals should be preferred. The notice should be served on all persons interested in the boundary and acknowledgments with date should be obtained in token of the service of the notice. The notice under Section 10 (2) should give the purport of the decision passed and the time within which and the officer to whom, an appeal may be preferred. Acknowledgments with date are obtained as for 9 (2) notices.

The notification under Section 13 is issued after the expiry of three months from the date of service of the notice under Section 9 (2) or 10 (2) and, if any appeal is filed, after the disposal of the appeal. The notification declares the survey final unless modified or set aside on a suit instituted within three years from the date of the notification. This notification must be published in the District Gazette and a copy posted on the village chavadi. The Tahsildar is responsible for the publication of the notification during 'maintenance.' He should publish them in batches every month.

For the purpose of enforcing maintenance notices under Section 15 (2) should be served on the registered holders responsible and acknowledgments with date obtained in a book kept for the purpose. The forms of the notice and of the register of acknowledgments are given in B.S.O. 34-A, Appendix II, paragraph 7.

If the registered holder or other person on whom any of the notices is to be served is absent, service may be effected by delivering it to some adult male member of his family at his usual place of abode or to his authorised agent or by affixing it on some conspicuous part of his last known residence or on some conspicuous part of the land to which the notice relates. When service is effected by so affixing the notice, the serving officer should note the method of service on the acknowledgment which is returned to the officer who issued the notice.

In the course of 'maintenance' occasions arise when the formalities under the Survey and Boundaries Act have to be observed. These occasions are when the already determined boundary is altered or when new boundaries are determined, *e.g.*,

(1) When the boundaries on the ground disagree with the records—B.S.O. 34-B (1) (8).

(2) Acquisition of land for public purposes—B.S.O. 90.

(3) When new fields are created out of surveyed waste blocks–B.S.O. 34-A (11).

(4) When corrugated boundaries are straightened—B.S.O. 34-A (16).

(5) Sub divisions affecting poramboke boundaries—B.S.O. 34-A (10).

(6) New survey of unsurveyed blocks and disforested areas, etc.

In all such cases the formalities under the Act should be strictly observed so that finality may be claimed for the boundaries as surveyed.

These formalities are not, however, observed in the case of sub-divisions measured in holdings as they are measured with the consent of the registered holder and as the parties concerned will look to their boundaries themselves.

Care should be taken to issue the notices and notifications in the proper form and to get them served and published in the prescribed manner.

An extract from the relevant provisions of the Act and the forms of the notices under Sections 6, 8, 9 (2) and 13 will be found in Appendix III.

CHAPTER XVII—MAINTENANCE.

The period of settlement is fixed at 30 years. At almost every re-settlement hitherto it has been found necessary to have a preliminary resurvey. To precede resurveys it has also been found necessary to entertain special staffs whose principal function has been to bring revenue registry up to date and incidentally to prepare lists of cases where alteration of the survey record is necessitated. The need for resurvey in each case has depended on a number of factors of which the weightiest has always been the adaptability of the system of survey employed to the requirements of the revenue administration. It is a curious commentary on the divorce that for so many years persisted between the Survey Department and the Revenue Department in whose interest the work of the former was carried out, that the requirements of every day revenue administration were so seldom taken into account in deciding upon the system to be adopted. Considerations of economy seem invariably to have controlled the decision and the thirty-year period of settlement was regarded almost universally as a period to be followed by a general and drastic revision of the survey and of the classification of the land. The modern idea of maintenance has for its ideal a gentle but more efficient way. It cannot be satisfied with anything less than a complete record accurate at any time in the course of the settlement.

The system of maintenance then pre-supposes a record of holdings handed over by the Survey and Settlement Departments which has to be preserved and, where necessary, corrected and altered as requisite. The technical meaning of maintenance is the preservation, correction and alteration of the records handed over by the Survey and Settlement Departments.

The records handed over by the Survey Department which we require for Revenue administration are the village map and the field atlas, and that handed over by the Settlement Department is the printed Diglott. No reference is specifically made here to the village B Register. This is not separately prepared at the time of each re-settlement though permanent changes have to be noted in the register as in Register A.

The general object of maintenance is to provide an up-to-date and authoritative record for every-day Revenue Administration. This is done (1) by providing the Taluk Tahsildar with an accurate and up-to-date copy of the permanent A Register with reference to which assessments on individual holdings can be ascertained and transfer of land from one head to another can be disposed of easily ; and by providing a similar record for preliminary and ready reference in the village ;

(2) by providing the inspecting officers with a village map with reference to which they can identify readily the position of survey fields ;

(3) by providing a record of measurements of individual fields and sub-divisions which will enable the officer to identify boundaries of holdings, settle disputes and detect encroachments ;

(4) by keeping intact a sufficient number of stones on the ground to facilitate identification of fields ; and

(5) by equipping the Land Revenue Officer with an up-to-date registry of persons responsible for payment of land revenue so that he may depend for their collection in due time and from the right party not on the personal knowledge or the private account of the Karnam but on the authorized Village Manual of Accounts.

The particular objects of maintenance are to dispense with the necessity for special staff and resurvey working in advance of each re-settlement which means cost, worry and harassment to the ryots and which considerably disorganise the revenue administration.

Description and Use of the Records.

(i) The Diglott, or, the village A Register, is the authoritative record for the settlement and revenue particulars of every field and sub-division in the village. It forms the whole basis of the Revenue Administration. It gives the specification—tenure, Government or Inam, dry, wet, unassessed or poramboke, source of irrigation, class and sort of soil, taram, rate per acre, extent and assessment of each field and sub-division. Reference to this record is necessary to ascertain the assessments on individual holdings and to dispose of cases of transfers of land from one head to another.

(ii) The Atlas of field maps contains pictorial representations of the survey fields and sub-divisions recorded in the A Register. A record of measurements of individual fields and sub-divisions is thus provided which will enable any inspecting officer readily to identify the boundaries of fields and sub-divisions whenever they may be required for the investigation of disputed boundaries, for the detection of encroachments, for the measurement of further sub-divisions and for the determination of the extents liable to miscellaneous charges, such as fasaljasti, tirvajasti, etc. The first essential for proper maintenance is a suitable survey basis consisting of a map of each field containing in itself the data necessary to relay the boundaries on the ground and to reproduce them on paper without reference to measurements exterior to the field.

(iii) The village map is a key to the field Atlas. It is intended mainly to act as an index to the field measurement book so as to enable an inspecting officer to identify any field independently and to make sure that the correct field has been pointed out to him. It gives an idea of the relative positions of survey fields, in other words, the 'lie' of the survey fields. With the help of the village map, you are able to find out where a particular field is and to get to it. Having

got to it, if you require the other particulars regarding the field such as the measurements of its boundaries or the number of sub-divisions in it, you have to refer to the Atlas.

SCALE OF DISTRIBUTION OF THE DIGLOTT, FIELD ATLAS AND THE VILLAGE MAP.

So far as the Diglott is concerned, it is enough to know that it is supplied to all Tahsildars, Divisional Officers and the Collector and to the Registration Department. For preliminary and ready reference in the village a copy is supplied to Karnams.

As regards village maps, the scale of distribution will be found given in paragraph 7 of B. S. O. No. 34 A. The maps will be all on the 16″ scale.

The rules hitherto in force in regard to field maps were that five sets of ferro-prussiate copies of each field map should be prepared—one set for the village, one for the Taluk Office and the remaining three for sale to the public. The manuscript duplicate copies were lodged in the Collector's Office. Under recent orders however, there will be only three manuscript copies of the field measurement book the triplicate being pricked off. The triplicate copy will be issued to the Karnam for use in the village, the duplicate will be issued to the Taluk Office and the original record lodged in the Central Record Office. (*See* B. P. No. 278 R. S., dated 13–10–1916). When the public apply for copies of the field maps, they are prepared in manuscript from the maintained copies, rules for which have been prescribed in B. P. No. 277 R. S., dated 23–11–1917 and are given in paragraph 6 of B. S. O. 34 A.

Maintenance.—What are maintained and why ? (B. S. O. No. 34-A, para 3).

The system of Land Records maintenance thus comprises the maintenance

(i) of the permanent village registers giving particulars of the description, classification and tenure of each field and sub-division

(ii) of an atlas of field maps giving the measurements to scale of each survey number and sub-division

(iii) of a village map which serves as a key to the field maps both in office and in the field and lastly

(iv) of the survey marks on the ground.

The maintenance of stones is given rightly the last place. The maintenance of the survey marks is only auxiliary to the real maintenance of the registers and records. To enable the maintenance of the latter, boundaries and holdings have to be identified with rapidity and exact points must be readily available from which measurements can be taken with ease and rapidity. Survey marks are thus a great convenience and the number necessary and sufficient for easy and rapid identification has to be maintained.

It should also be noted in this connection that no records can be said to be maintained up to date unless the registry is up to date. The usefulness of the existing revenue records is greatly marred by the fact that revenue registry is never up to date. "It is sheer foolishness that the Karnams should have to prepare a set of village accounts annually, especially, accounts 10, 11, 13 and 14 which are mere waste of paper because the names of half the pattadars are wrong and should be driven to maintain a set of correct private and unauthorized accounts in order to collect the revenue from the right persons. This system puts the Tahsildars entirely into the hands of Karnams." Collection work would be much easier if the registry of pattadars were correct and up to date. And the primary object of the records being for revenue purposes, the importance of keeping registry up to date cannot be over estimated.

This system of maps, registers and marks on the ground is devised for the purpose of every day revenue administration in the ryotwari tracts of this Presidency. The more correctly and completely the system is maintained, the more easily and readily can the various rules of Revenue account be applied, collections be enforced, and disputes settled ; and the more accurate and complete will be the statistics of economic condition such as those showing the size of individual holdings, the average rates of revenue paid and so forth.

The four factors of revenue administration cannot be divorced, *viz.*, the registry, the holding, the mapping and the demarcation. The names of actual holders of land must be made to correspond with registers, changes of registry must be followed by corresponding changes of survey fields or sub-divisions entered in maps and new fields or sub-divisions entered in the maps must result in simultaneous alteration of demarcation.

The maintained records are (i) the permanent A and B registers in the Taluk Office—the duplicates of the registers in the village which can be regarded as the copy for use, (ii) the copy of the Atlas of field maps kept in the Taluk Office which is known as the Taluk copy, the other copy in the village being the copy for use in the village, known as the village copy and (iii) the set of village maps which is in the custody of the Inspecting Tahsildar.

CHAPTER XVIII—CORRECTION OF ERRORS—B. S. O. 34 B.

You have seen in actual work how errors are inevitable in a survey especially when it is carried out on a large scale and under different systems by different persons under different circumstances. In how many ways errors can creep in and in how many ways they manifest themselves have been explained in the introductory chapter Such errors, when detected, should be corrected before the record can be used either for current work or for recording subsequent changes.

What are the records to be corrected ? So far as the maintained sets of records are concerned, they comprise the maintained Taluk Copy of the F. M. B.

the maintained taluk copies of the A and B registers and the 'maintained set of village maps in the custody of the Inspecting Tahsildar. The corrections in the former two have also to be carried out in the village copies of the Field Atlas and the A and B registers because they are the copies for use and reference in the village and no detected errors should be allowed to continue in them.

At times as, for instance, when there is discrepancy in the boundary between two villages and also when theodolite stones come to be replaced, the original traverse records require correction. These records are kept in the Central Survey Office at Madras and the corrections will have to be carried out in them.

Agency authorized to correct :—So far as the traverse records are concerned the Survey Office has to carry out the correction on the corrections being reported to that Office. In regard to the other records, the nature of the errors decides the Officer competent to carry out the correction.

Classification of errors.—Errors and discrepancies in the Survey records which are discovered in the course of sub-division, stone maintenance or other work, or which are already entered in the error lists furnished by the Survey Department, can be classed under three heads :—(i) errors of measurement, (ii) errors of shape and (iii) errors in area. Some of the errors again can be rectified in office while others require investigation on the ground.

The limit of measurement error allowed as well as the manner of correction and the officer competent to carry out the correction are detailed in B. S. O. 34 B.

Investigation of survey errors on the ground.—In investigating survey errors on the ground, the following points must invariably be borne in mind :—

(1) Verfication of terminal points

(*a*) by the recorded measurement,

(*b*) by the limits of occupation.

(2) location of the error.

(3) rectification of the error.

The officer investigating the survey error should not assume that a survey mark seen by him on the ground is in its correct place unless its position has been verified by measuring at least two, if possible three lines, converging to it. He shall note in a true tracing taken from the field map, in black and red ink respectively, the recorded and the actual distances of such lines whether the difference be within or beyond the admissible margin of error. A brief note explaining the necessity for the investigation of the error and the proposed alteration should be made in the sketch.

Error in measurement.—When measurements of individual lines are affected but not the shape or area of the field, the Revenue Inspector can carry out the necessary correction in the village copy of the Field Measurement Book, note the fact on the sketch and submit it to the Tahsildar.

Error in shape.—When the error involves an alteration in shape but not in area, the Inspector shall not carry out any correction in the village copy of the Field Measurement Book on his own authority but shall prepare in addition to the skecth mentioned in the above paragraph a neat sketch of the field as revised by him in a form fit to be inserted in the Field Measurement Book. He shall submit both the sketches to the Tahsildar, who will after examination return them to the Inspector with instructions either to correct the plotting in the Karnam's copy of the Field Measurement Book or to insert the revised map in it. The Inspector shall resubmit the file after necessary action to the Tahsildar. When the revised map is inserted in the village copy of the Field Measurement Book the Inspector shall prepare and put up a copy of the same in the file for insertion in the Taluk copy.

When the error involves alteration in area or both in shape and area.—Errors in area occur usually in two ways (i) where there is nothing wrong either in the measurements or plotting but the area computation is wrong and (ii) where the mistake in area arises from wrong measurements or wrong plotting. When the error involves an alteration in area or both in shape and area, the Inspector shall, in addition to the two sketches mentioned in the above paragraph, prepare an extract from the permanent A register containing all the entries relating to the Survey field and put up draft notices in duplicate. The actual areas of the sub-divisions and of the whole field as revised shall be computed by the Inspector and entered. No adjustment of the areas should be made when the difference between the recorded and the actual areas exceeds 5 per cent. The actual and recorded areas should be entered separately in ink on the face of the sketch under the Inspector's initials. The Taluk Tahsildar will get the notice served on the party or parties concerned, record on the duplicate copy of the notice the fact of service and an abstract of his order on objection, if any, received with reference to his notice. He will then prepare a memorandum of alterations and submit it to the Collector for approval. When the alterations have been approved by the Collector, the file will be sent back to the Taluk Tahsildar who will get the village copy of the Field Measurement Book and the permanent A register corrected by the Inspector and the Taluk copy of the A register by a member of his own establishment. The corrections should also be carried out in the Taluk Copy of the Field Measurement Book.

Cases where there is no defect in the Survey records but the boundaries on the ground disagree with the records.—The above rules provide for the correction of the survey maps only in cases where there is an omission or discrepancy in the record itself requiring investigation on the ground. Where there is no such error in the record but the demarcation is discrepant with reference to actual limits of occupation, the fields must be resurveyed in accordance with actual facts of enjoyment, except in the case of porambokes where each case will be dealt with on its

merits. Where there are no plainly marked limits and where the boundaries are disputed, the cases must be dealt with under Act VIII of 1923.

Alteration to be reported to the Director of Survey.—Besides the traverse corrections referred to already all alterations made in village boundaries of such magnitude as to be perceptible on the scale of one inch=one mile should be reported to the Director of Survey.

Corrections to the printed diglott Register.—These should be printed and communicated to all officers to whom copies of the register are supplied. A printed copy should also be sent to the Board of Revenue in the Settlement Department.

CHAPTER XIX—MAINTENANCE OF DEMARCATION.

By maintenance of demarcation is meant the maintenance of the survey marks on the ground.

What is a survey mark.—A survey mark under Act VIII of 1923 means any mark or object erected, made, employed or specified by a survey officer to indicate or determine or assist in determining the position or level of any point or points.

Utility of survey mark.—The Survey Department do not require the marks so much for mapping as the Revenue Department for administrative purposes. We are constantly using our survey in every day work not only for identifying the fields measured but also for measuring and mapping subsequent changes. Easy identification is also necessary to detect and repress encroachments—accidental or deliberate. Survey marks have, therefore, to be permanent and durable and have also to be preserved.

Limiting demarcation.—Until the idea of maintenance of the surveys started, the necessity of limiting demarcation to the minimum absolutely necessary was not taken into consideration though the slow progress and cost of the Madras system of survey were constantly attracting attention. The demarcation of all bends and all sub-divisions was carried on to a minute degree. In 1883 the Surveyor-General of India observed, 'I was much impressed with the accurate character of the Madras maps and with the minute internal demarcation of fields by which a vast number of permanent marks were left imbedded at the bends of the partitions. Demarcation in Madras is of a very elaborate nature; it costs more than half as much as the survey of fields. I would advocate the demarcation of boundaries of plots containing more than one field, covering areas of some arbitary but fixed number of acres as in Bombay'. The question of reducing demarcation and indeed of possibly eliminating field stones altogether was discussed by the committee in 1887. But subsequent events tended to more demarcation, all the sub-divisions also being ordered to be demarcated. To demarcate all sub-divisions would mean an enormous increase in the stock of survey stones in the ground and the task of maintaining those marks would be one of continually increasing magnitude as fresh sub-divisions follow year after year. The expense to the ryot will also be

great. The multiplication of survey marks on the ground will obscure those which are really important. Identification is easy with a few stones around the corners of a field but with a number of stones for every minute sub-division it is rendered tiresome. Maintenance would also be impossible. The more we add to the number of stones the more work we throw on the Karnam and this is directly contrary to the principles of administration.

The knowledge, therefore, (1) of the cost and delay in the survey operations due to unnecessary and excessive demarcation, (2) of the uselessness of such minute demarcation and (3) of the practical impossibility of maintaining the survey marks, rendered necessary some modifications in the rules so as to keep demarcation within the absolutely necessary minimum. The clubbing of survey fields and holdings during survey and, in some cases, in maintenance, has been ordered in order to prevent excessive demarcation. And in original surveys demarcation is restricted to (i) Theodolite stones (because they form the frame work of the entire Cadastral survey), (ii) field trijunctions (because they form the frame work of the survey field, the survey unit), (iii) terminal points of 'G' lines not coinciding with either of the above (because on the lines connecting these points depend the positions of the other bends in the field), (iv) bends on village boundaries, (v) bends on Poramboke fields and sub-divisions (because these lands have to be preserved and encroachments on them prevented, in order to safeguard public and communal interests) and (vi) minor circuit stations. "The multiplication of marks would be an evil rather than a benefit. On the other hand, the maintenance of the principal survey marks of a permanent character is all important". The whole aim of demarcation maintenance is concisely stated in this sentence. The policy always must be to cut down the number of stones, wherever possible, and not to increase them. This must always be borne in mind when checking new sub-divisions. For the purpose of azmoish and field inspection the presence of stones on a large scale is unnecessary as there are almost always clear physical boundaries and well marked details.

Responsibility of the ryots.—Under section 15 of Act VIII of 1923 every registered holder of Government land shall be bound to maintain, renew and repair the survey marks on or within the boundaries of his holding and in default of his doing so the survey officer may maintain, renew and repair such survey marks and recover the cost as an arrear of land revenue. Rules to give effect to this have been prescribed and are given in App. I and II to B. S. O. 34 A.

Any district that has secured the co-operation of ryots in the preservation of survey marks has automatically solved the question of stone maintenance. The ryot's responsibility is imposed by the Act itself. The ignorance, however, on the part of the ryot, is amazing. This responsibility is now brought home to him—whenever he neglects to maintain the survey mark on the boundary of his holding by recovering from him the charges incurred on account of the renewal or repair. But more effective than this will be the preaching which all Revenue Officers should not neglect. The ryot must be told that he knows the stones marking the limits of

his holdings much better than the Karnam or any other inspecting officer, that he visits his holdings off and on throughout the year for ploughing, sowing, weeding, harvesting, etc., operations, that he is in the best position, without anybody drawing his attention to it, to know the condition of each survey mark around his holding and that, if he finds anything wrong, he can himself do the needful in time or get it done with the aid of the Karnam of the village. It must be particularly brought home to him that neglect of stone maintenance in the past has to a large extent been responsible for the periodical resurveys which mean so much worry and expense to the ryots.

How stone maintenance is carried on.—For working these rules, the stones in each field are numbered and a register is maintained in which the survey number responsible for the maintenance of the stone is entered. The register also provides sets of columns for five years for noting the result of the inspection and the action taken either by the ryot or by the maintenance officer. Numbering of the stones was till recently done in eye sketches of 20 to 25 fields in a page, which were bound into a book form and indexed. The Theodolite stones (village trijunctions, village boundary stations and Khandam stations) are numbered in one series for the whole village. The field stones are numbered in one series for each field separately, the numbering being done in the lowest number. Sub-division stones are under the existing orders counted in continuation of the field stones—the numbers of the stones alone but not the sub-division line being shown in their approximate position in the sketch. The Theodolite stones are entered in stone register A and the field and sub-division stones in stone register B.

The preparation of the demarcation sketch has recently been given up in certain cases. The stone numbering is done in a copy of the 16″ village map except in triangles areas. The numbering is done in the map itself, or when this is inconvenient for stone inspection, the map is cut up and used as demarcation sketches.

The record of stones and the stone registers being ready, the Karnam inspects the stones and notes their condition. A stone should be considered as intact when it is

(1) in its correct position

(2) firm

(3) plainly visible and (4) accessible for purposes of measurement.

The firka inspector is responsible for the adequacy and genuineness of the Karnam's stone inspection. In respect of stones found to require renewal or repair, notices under Sec. 15 of the Survey and Boundaries Act are got signed by the firka Revenue Inspector and served on the registered holders of the fields responsible for the maintenance of the stone in the manner provided by the rules. The village officers have to persuade the ryots to attend to the stones before the maintenance officer's visit and, when the latter actually visits the village he renews and repairs such of the stones as have not been attended to by the ryots and, in respect of the stones attended to by them, checks all cases of renewal and re-plantings and

ten per cent. only of other repairs. The maintenance officer is authorized to employ hired labour where necessary and to incur the charges from the permanent advance allowed to him. Stones necessary for renewal he obtains from the village depot. Bills are prepared by him for the charges incurred in different sections according as the amounts are recoverable from private or public bodies or are chargeable to Government. Cost of hired labour is charged both in the case of renewals and repairs together with, in the case of a renewal, the cost of the stone at the village depot.

Survey marks falling in the bed of a river, stream road, etc., where it is impossible to maintain them will be abandoned while bijunction stones between fields in the occupation of the same man will also be abandoned in triangles areas.

Abandoned stones are not, however, removed from the registers. They continue to be shown in the registers and are for statistical purposes treated as intact.

Amendment of stone registers :—The sketches and stone registers would require amendment when new poramboke sub-divisions are measured and demarcated, when new fields are formed or existing fields are revised and also when for any reason there is fresh demarcation or elimination of existing stones, *e.g.*, when an assessed waste is transferred to poramboke or a poramboke is transferred to ayan. Col. 2 of the stone register should also be revised whenever new sub-divisions are measured.

The proper maintenance of demarcation is ensured :—(1) By scrutiny of the Karnam's stone inspection by the superior Revenue Officers, (2) by watching the fortnightly stone inspection progress report sent by the firka Revenue Inspector along with his diary, (3) by seeing that new stones planted are brought on to the stone registers and the stone registers are suitably amended when sub-divisions have been measured and (4) by watching the arrears under stone maintenance as disclosed by the periodical returns.

Method of replacing missing stones :—See Chapter X of the Chain Survey Manual.

CHAPTER XX—MAINTENANCE OF FIELD MAPS.

Supply :—Three sets of field measurement books are prepared in manuscript for all villages—(B. P. No. 278/R. S. dated 13–10–1916). The original is lodged in the Central Record Office, the duplicate will be in the Taluk Office and the triplicate in the village.

Maintained set :—The maintained set is the one in the Taluk Office. No changes should be recorded in this set except under the orders of the Inspecting Tahsildar by the Draftsman or the Deputy Surveyor or a taluk clerk trained in survey. Copies of field maps granted to private parties have to be prepared with reference to this set and certified to be correct. All the changes recorded in this

set are also previously made in the copy of the field measurement books with the Karnam because the latter is the set for use and reference in the village.

How maintained :—(i) by incorporating all sub-divisions sanctioned and measured in accordance with the rules detailed in B. S. O. No. 34-A paragraphs 9 to 13;

(ii) by carrying out all corrections that may be sanctioned under B. S. O. No. 34-B;

(iii) by incorporating the new fields and inserting individual sketches of new fields that may be measured under the rules in paragraph 11 of B. S. O. No. 34-A read along with B. S. O. No. 90 and

(iv) by carrying out necessary alterations where sub-divisions are clubbed —paragraph 15 (*c*) of B.S.O. No. 34-A and B. P. No. 96 R. S., dated 8–5–1917.

How the incorporation of the changes is watched and ensured :—

(i) by the Cols. specially provided in Taluk Registers 4, 5, 6 and 7 for exhibiting cases affecting portions of survey numbers;

(ii) by register 8-A of the Taluk Manual of accounts (B. P. No. 2018 Mis. dated 22–6–1928) in which all cases of sanction of sub-divisions or new numbers by all officers are entered (B. P. No. 283 R. S., dated 7–12–1917, para 11 B. S. O. 34-A) and which gives all the different stages until the incorporation of the changes in the maps and in the records;

(iii) by means of the half yearly and annual returns;

(iv) by a general check at the time of the jamabandi whether all sub-divisions have been plotted.

CHAPTER XXI.—MAINTENANCE OF VILLAGE MAPS.

Supply :—See for scale of supply B. S. O. 34-A, paragraph 7.

Maintained set :—The set of village maps in the Collector's Office. The maps should be kept flat and should not be folded or rolled up (B. P. 233 dated 22–8–1916).

How maintained :—

(i) By incorporating all topographical details which come to notice from sub-division records and acquisition sketches which pass through the Inspecting Tahsildar;

(ii) By incorporating new fields formed in waste blocks or in connection with Land Acquisition; and

(iii) By carrying out the alterations in the boundaries (*a*) that have already been sanctioned by the Director of Survey, (*b*) that may hereafter be sanctioned under B. S. O. 34-B. *See* Appendix V to B. S. O. 34-A.

CHAPTER XXII—MAINTENANCE OF REGISTERS.

The maintained registers are the permanent A and B registers in the Taluk Office, the duplicates of those kept in the villages. The latter which are required for reference and use in the villages are also maintained up to date.

All new sub-divisions, including cases in which sub-divisions are measured as new numbers, and also all permanent changes such as transfer from Inam to Government, dry to wet, single crop to double crop, poramboke to ayan and *vice versa*, are to be entered in these registers. All corrections sanctioned in accordance with B. S. O. 34-B are also carried out. Such of the permanent changes as affect Inams should be entered in the permanent B register also. These registers are thus kept up to date except in so far as the registry of the names of holders of occupied lands is concerned. Changes in the names of registered holders are entered only in village accounts 2 and 10.

The permanent registers in the village and taluk are sometimes interleaved and the corrections are noted in them. Changes in respect of whole numbers should be entered in the Taluk Registers as orders issue, first getting a report that the village register has been corrected. Similarly, the Karnam should enter the changes in whole numbers in his permanent registers and in village account No. 3 on receipt of the orders communicating the change. So far as sub-divisions are concerned, the officer responsible for the check measurement of the sub-division makes the necessary alteration in the village accounts while similar changes are noted in the Taluk Office after the sub-divisions are incorporated in the Taluk copy of the Field Measurement Book. In all cases, the number and date of the order sanctioning the change should be quoted in the register and the entry attested and dated.

The following registers which are maintained in Taluk Offices are intended to provide a record of all changes entered in the permanent registers.

Registers	4	..	Darkhasts.
Do.	5	..	Relinquishments.
Do.	6	..	Transfers.
Do.	7	..	All other permanent changes.

In the village, the changes are first noted in annual account No. 3 (register of changes).

No. 8 A is only a D. C. B. of sub-divisions sanctioned under the other registers.

How the up-to-date maintenance of the permanent Register is watched and ensured :—

(1) Each of the accounts 4, 5, 6 and 7 contains columns to show the cases involving sub-divisions. These sub-divisions should find place in Register 8 A. The latter register contains columns for incorporation in the Taluk copy of the F. M. B. and correction of the permanent A Register.

(2) Before the current in the 8 A register is closed the Tahsildar has to see that the change has been noted in the A Register and record a certificate to this effect on the sub-division record.

(3) As regards changes noted in Taluk account 7 concerning *only* whole numbers the instructions for the preparation of the account direct that the changes must be noted in the A Register after getting a report that the village accounts have been corrected.

(4) The corrections in the village permanent register so far as sub-divisions are concerned, are insured by making the check measuring officer certify on the sub-division sketch that the village accounts have been corrected.

(5) The correction of the village records is scrutinized by the examination of No. 3 and other accounts during inspection by superior officers.

(6) The Taluk registers are examined by the Divisional Officers and the entry of changes therein is checked. The questions to be answered by the Divisional Officers will be found in the B. S. O.

(7) The two sets of registers (Village and Taluk) are compared at the time of Jamabandi when omissions, if any, are sure to come to notice.

CHAPTER XXIII—MAINTENANCE OF REGISTRY.

By transfer of registry is meant alteration in the names of the registered holders. The form of patta issued in the case of ryotwari holdings is the form given in village account No. 11. This form contains particulars of the fields in the holding, their assessment and also the monthly kists.

The rights and obligations under a patta are given in B. S. O. No. 28. To the Government a registered holder is the responsible proprietor. The patta is not a muniment of title. More properly, it is a record of obligations. The document indicates only certain fiscal arrangements between the Government and the individual whose name is mentioned in the patta. The whole problem of transfer of registry is the problem of making the revenue registry harmonise in a greater degree with actual facts.

But the chief difficulty about keeping the registry up to date is the apathy of the ryot who so long as the patta is not a muniment of title as against private persons, and so long as failure to report transfers does not render him liable to any penalty, is never anxious to report the transfer and get the patta transferred in his name. As the rules stand at present, the Government itself has to ascertain the changes and bring the registry up to date.

Provided that the land upon which any revenue is due can be accurately located, the Revenue Recovery Act ensures the safety of the revenue. But bad registry must leave the distribution of the assessment in the hands of the village officers. If, therefore, the registry is not up to date, to that extent the villagers are in the hands of the village officers for the distribution of their

actual dues. The dependence on, and the subservience to, the Karnam and his note book (*Anubhogapatti*) on the part of the Taluk Tahsildar is great. It is also hard on the ryot that he should be placed entirely in the hands of the Karnam to know the amount of revenue payable by him. It may be that the present method of keeping the accounts does not impede the collection of revenue though village officers occasionally bring an absentee ryot into trouble and complaints as to excess collection etc., are not rare. But there is clearly no use maintaining a list of holdings and a set of village accounts with fictitious names entered against half the pattas in the village. Though the absence of an up-to-date registry does not seriously hamper Revenue collection—an up-to-date record will certainly facilitate it—it will hamper *general administration*, *e.g.*, whenever it is necessary to undertake large operations such as Settlement or Survey which involve the serving of individual notices on the owners of the lands affected by the operations. "It will lead to delays and failures of justice in those transactions in connection with which a notice has to be sent to the concerned land holders (*e.g.*, Darkhasts) and in cases in which the holder of a land has cause to make any application to Government regarding his holding (*e.g.*, cases of application for remission or for loans on the security of land)." It is practically useless to summon a registered holder who possesses no real interest in the land and to take a statement from him and it should be vexatious to all concerned that fictitious owners should be addressed in so many cases by the several departments of Government such as the Survey, Settlement, Land Records and Public Works that have to deal with the owners of lands and to issue notices to them. No system of maintenance can therefore be considered perfect unless the registry is up to date.

As under stone maintenance, maintenance of registry is capable of easy solution with the willing and constant co-operation of the ryot. At present it is possible for the process of alienation of lands to proceed for generations without restraint and without the holders or occupiers of land taking any steps to bring the facts on record in the Revenue registers; so that frequently it is extremely difficult to reconcile the patta with the actual enjoyment. In addition, ownership may devolve by succession without the successor taking steps to correct the revenue registry. In the absence of any co-operation therefore, on the part of the ryots, either voluntary or compulsory, Government has to do what it can by utilising all available sources of information regarding changes in holdings and giving effect to the changes wherever possible. The rule always is to effect the change rather than refuse it. Most of the permanent alienations of land have, under the Registration Act, to pass through the Registration Department. A closer contact has therefore been established between the Registration Department and the Revenue Department, by the orders requiring the former either to obtain, for transmission to the latter, from parties to documents evidencing permanent alienations of land, applications for transfer of patta, or, failing such applications, to furnish that department with notices of such transfers (G.O. 3150 Rev., dated 3-11-1914

and revised B. S. O. 31). Cases of succession due to death of the registered holder have to be reported by the Karnam every month, in the form of enclosure A to village account No. 10. And, as regards other cases of absolute transfer, the Karnam has to submit a list every month in the form given in B. P. No. 58/L. R., dated 6-3-1918, Appendix XLVI to B. S. O. 31 and B. S. O. 31, para. 5 (i). Mere transfer of registry resulting in the multiplication of joint pattas is no good. Where portions of Survey numbers are affected, sub-divisions must be effected wherever possible. Practically, the sound reasons for rejecting an application for transfer resolve themselves into three :—(1) that patta already stands in the name of the person that applies for it ; (2) that transfer is applied for in virtue of a right to dispose of the land which another party will not admit, *i.e.*, when there is a *bona fide* civil dispute between two parties as to the right to transfer the land ; (3) where the transaction which leads up to the application for transfer is shown to be fraudulent. So far as the second class of cases is concerned it is part of the Tahsildar's duty to enquire into the *bona fides* of the contesting claims, not into their merits, for that is the function of a Civil Court, but to satisfy himself that the counter claim is not merely obstructive, ignorant or with intent to defraud.

It must never be forgotten that the object of the enquiry is to ascertain the names of persons who, in virtue of their title, whatever its nature, are in the enjoyment of the lands and who are responsible for the payment of revenue. The enquiry should therefore be restricted to the extent necessary to ascertain this. The work is best done by being attended to regularly and systematically and also publicly in the villages concerned.

Up-to-date registry is watched and secured as follows :—

(1) The procedure has been simplified by making the enquiry as summary as possible.

(2) All cases of absolute transfers coming before the Registration Department are brought to the notice of the Revenue Department either by means of applications or intimations.

(3) Firka Revenue Inspectors have been given enhanced powers in the matter of disposal of transfer applications.

(4) Under paragraph 5 (ii) of B. S. O. 31 every Firka Revenue Inspector has to inspect every village in his Firka once in each half-year and ascertain and dispose of every outstanding case of transfer in that village and the Tahsildar and Deputy Tahsildar should check the Revenue Inspector's work in one or two villages in each Firka annually.

(5) The disposal of transfer applications by Firka Revenue Inspectors is watched by making them give the figures of such disposal in their fortnightly diaries (B. P. 306/L. R., dated 11-11-1916) and by inspection of their registers in Form 6-1 by inspecting officers.

(6) The rejected cases are particularly scrutinized by Divisional Officers at the time of inspection of the Taluk Register 6. The number of rejected cases has to be noted in Jamabandi statement No. 10 (B. P. 20 L.R., dated 15-1-1916) ; and, if the rejected cases exceed 5 per cent. of the total number disposed of, explanation has to be furnished in the Jamabandi report (B. P. 59 L.R., dated 18-4-1917).

(7) Monthly statements have to be submitted by Karnam for cases of transfer not otherwise brought to notice (B. P. 58 L.R., dated 6-3-1918).

(8) In order that transfer of registry might be properly carried out and the change properly mapped, when a portion of a land is transferred, sub-divisions must be effected unless sub-division is not possible (*vide* foot-note to the form of transfer application B. S. O. Vol. II page 160 and B.P. No. 197 L.R., dated 1-7-1915).

Read B. S. O.s 27, 28 and 31 and L.R. Committee Report, paragraphs 57 to 93.

B. P. 58 L.R., dated 6-3-1918. Prescribing a form for submission by the Karnam of cases of absolute transfer in which neither party has applied for transfer. (Note. This B. P. authorizes the publication in the District Gazette of a note on the objects and principles of Revenue registry.)

B. P. 180, dated 11-11-1920. Standardized form of questions on P. T. R. applications.

CHAPTER XXIV—SUBSIDIARY REGISTERS.

The several Standing Orders under which changes in the description of lands can take place you will find enumerated in paragraph 9 of B. S. O. 34-A. For the purposes of the Taluk and village Manual of Accounts these changes are broadly divided under four heads (1) Darkhasts, (2) Relinquishments, (3) Transfers and (4) other permanent changes. In the villages all these changes are entered in one register (village account No. 3) under different sections. In the Taluk they are posted respectively in registers 4, 5, 6 and 7. These registers contain columns specially provided to indicate cases where portions of fields alone are affected and sub-divisions have been measured. The sub-divisions so sanctioned under all these registers are entered in a special register 8-A. This register, if properly posted, should account for all the sub-divisions sanctioned in the Taluk and it is with reference to this register that the progress in the check-measurement and mapping of sub-divisions is watched.

In checking these Taluk registers attention must be paid to the following :—

(1) The registers should be in the revised forms, *see* B. P. 35, dated 21-5-1929, B.P. 48, dated 7-6-1928, B.P. 52, dated 23-7-1929 and B.P. 2018, dated 22-6-1928,

(2) They should be maintained for each fasli. It is a very common practice in certain taluk offices to close the registers at the time of Jamabandi. The Jamabandi is a fluctuating incident. The maintenance of the registers should not be made to depend on the time of the Jamabandi. They should be opened on 1st July and written up to the 30th June following. (3) Each register must have an index of villages prefixed to it and against each village the items in the register pertaining to it should be exhibited. (4) The writing up of the registers should be in conformity with the instructions in the Manual—particularly the maintenance of register No. 6 in different sections. (5) In all cases involving sub-divisions the order sanctioning the change should be issued at the same time as the sub-division is sanctioned and should not be postponed, as is sometimes done, till after the check-measurement of the sub-divisions. Remember that the Revenue Inspector check-measuring the sub-divisions has to quote the number and date of the order sanctioning the change in the village accounts. (6) Take up the files pertaining to cases involving sub-divisions—see if both the sub-division sketch and statement have been signed by the officer *competent to sanction the change*, that the certificate of check-measurement is complete, that the sub-divisions have been incorporated in the Taluk copy of the Field Measurement Book and the changes entered in register A or registers A & B as the case may be. (7) Examine the cases of rejection of transfers in Register No. 6 and see if the reasons are valid. (8) Check if the permanent changes in regard to whole numbers have been entered in permanent registers A & B. (9) Check the accuracy of the last half yearly or annual maintenance return so far as sub-divisions are concerned with reference to register 8-A and (10) also see if the quarterly return to the Registration Department is being regularly sent.

While checking register 4 see that the 'accepted' cases have been divided into Parts I and II and that the sub-division sketch and statement, if any, have been filed with the former. Also in the case of conditional assignments note if a specific report about the entry of the case in the village register of conditional assignments has been received and if the case has been entered also in the taluk register before closing the current. In the register of other permanent changes (Register 7) where changes have occurred in respect of whole numbers or sub-divisions see whether a specific report as to the entry of the change in the village accounts has been received and is in the file and also, where the change involves fresh demarcation or the elimination of existing demarcation, whether the case was communicated to the Revenue Inspector and a specific report obtained as to the action taken by him in the matter. In register 8-A particularly scrutinise the cases in which the issue of Survey notices is necessary and check whether the notices have been issued in the proper form and served or published in the prescribed manner.

CHAPTER XXV.—SURVEY ADVANCE ACCOUNTS.

(B. S. O. 34-A, Appendix II, Paragraphs 12 to 19.)

In the course of maintenance work survey marks have to be renewed where they are missing and new stones have to be planted in cases of formation of new fields and in certain cases of sub-divisions. The ryots are persuaded to renew the stones themselves and they have the option of demarcating sub-divisions other than those which require compulsory demarcation. By far the greatest and the most frequent transactions are only under renewal of survey marks effected both by the maintenance staff and by the ryots. You cannot obviously be ordering stones every time you require them and await supply. They have to be kept ready beforehand. In order therefore to provide an easily accessible stock of stones from which renewals may be effected both by the ryots and the maintenance staff, the Collector arranges to stock in each village in the custody of the Village Munsiff a sufficient number of stones of each description. Sub-division stones, as a separate category, will not be exhibited. They will be included under 'F' stones as the size and cost is the same. These stones can be utilized for poramboke sub-divisions and the letter 'S' chipped on the top at the time of use—B. P. 131, dated 12-6-1918. The number to be stocked in each village will vary with the total number of maintainable stones in the village as well as with the nature of the tract, the latter affecting the proportion of missing stones to the total number. In a wet tract, for instance, a greater number of stones are likely to disappear than in a purely dry one. It would be sheer waste of money to stock the same percentage of stones irrespective of whether the village is dry or wet. The general rule therefore is that the stock of stones should not exceed one per cent. of the total number of stones in each dry village and two per cent. in wet and should not at the same time be less than the number actually required for current maintenance.

You require capital wherewith to purchase the stones and this purchase, as you know, has to be made in advance of your commencing maintenance work. Also, in order to enable work incidental to renewals and repairs, such, for instance, as cost of carriage of stones to the workspot and the cooly charges for planting the stones or for clearing prickly pear or other dense vegetation, to be carried out and paid for then and there, the maintenance officer has to be provided with a small sum which he can recoup when necessary. The required capital is made available by the Board of Revenue sanctioning for each district an advance according to its requirements. Within the district the Collector distributes the advance to the several taluks. This advance is known as the *floating advance*. Out of it the required number of stones has to be purchased and stocked and the necessary advance to enable the maintenance officer to incur cooly charges has to be made. *Floating advance therefore may be defined as the maximum amount available at any time for the purchase of stones and for advance to maintenance officers.* Mark the words '*at any time.*' The advance is not in the nature of an allotment which is

made and is spent and done with. The cost of stones required for purposes of maintenance is not met from any provision made in the Budget estimates as is the case with other items of expenditure. The advance is required for current and every day work and has to be turned over as many times as may be necessary as in the case of permanent advance sanctioned for an office, the only difference being that whereas in permanent advance you draw the entire amount and keep it with you, in the case of a survey advance you draw it when you have purchased stones or when you have to give an advance to the maintenance officer.

The system of survey advance accounts deals with the manner of accounting for such advances. Necessarily, there must be an advance account for the money spent in advance. This amount has, as already explained, to be turned over as many times as may be necessary because we have to provide only for the minimum stock necessary at any time and we will be depleting the stock (which means the capital spent) as we go on working. Unless, therefore, we are able to recoup the capital to the extent to which it has been depleted we cannot always manage to keep up the minimum stock. Now then, the only way to recoup is to realise the value of all stones removed from the stock and realise also the charges for hired labour incurred out of the permanent advance allowed to the maintenance officer. When ryots purchase stones from the depot we always realise cash. But such sales are not frequent. The more frequent transactions are those where we do the work and subsequently collect the charges from the ryots on bills made. In some cases the charges are debitable to Government where the stones are planted on the boundaries between unoccupied lands. If all the charges incurred could be then and there recovered, the advance will be recouping itself. But the recovery will take time and some items may not be recovered at all. So far as the transactions under the bills are concerned there is, therefore, no good waiting until the amount of the bill is recovered, to recoup the advance. In order that there should be no delay in recouping the survey advance the amounts of these bills are shown as credit against the survey advance immediately the bills have been made and before any *collection* has been made thereon. The collection of the amounts of the bills is watched separately. *It is thus clear that accounts have to be maintained to see that the survey advance sanctioned for each district is not over-drawn, that it is recouped only to the extent of the value of stones utilized by the maintenance staff or sold to ryots, that the recoveries from the ryots are watched carefully and that the amount to be debited to Government is adjusted. It is also necessary to maintain registers showing the number of stones stocked in and issued from, each village depot.* In other words, two accounts are necessary (1) the advance account and (2) the Collection account. Under each of these there are administrative accounts for the maintenance of which the Tahsildar, the Divisional Officer and the General branch of the Collector's Office are responsible and the Treasury accounts for the maintenance of which sub-treasury officers and the Treasury Deputy Collector are responsible. The administrative and the treasury accounts are to be kept independently so that

their eventual comparison with each other may afford an independent check of their correctness. The administrative registers are :—

(1) The stock register which shows the stock of stones in each village at any time. This should be in Form I of Appendix II to B. S. O. 34-A.

(2) The register of survey advances and their adjustments prescribed in B.P. No. 245, dated 8-7-04 in Form V. This shows the debits and the credits under "Revenue Survey Advances—Collectors," "Cost of survey marks-collectors" and also the debits made against the departments of Government.

(3) *The Demand Collection and Balance register in Form VI.*

The stock register :—The stock register is kept in the taluk office and is posted by villages. It shows the number of stones of each description and the value fixed by the Collector. Stones are generally supplied to depots by a contractor and when a supply is made and the contractor has been paid, the number of stones supplied is entered in the register under the village concerned. A register in the same form is also kept in the village by the Village Munsif. From the stock in his charge the Village Munsif sells stones to ryots for cash at the rate fixed by the Collector, makes the necessary entries in his register and strikes the balance after each transaction and remits the sale proceeds to the taluk treasury on receipt of which the taluk office makes the necessary deduction in stock in the taluk register quoting the chalan number as the authority. When a maintenance officer visits a village and utilises the stones in the village depot, an issue is noted in the village depot register but no cash is recovered, the maintenance officer making only a bill. The bill when received in the taluk office is therefore the authority for the deduction in stock in the taluk register. A deduction in the village register as well as in the taluk register must therefore be supported by a cash receipt or bill in Form III. If the transactions are correctly reported and correctly posted, the two sets of registers in the village and the taluk office should agree in all respects.

So far, the taluk register enables us to keep up to date the total number of stones available for maintenance work in each village. We have to replenish deficiencies by purchasing fresh stock up to the limit of the advance sanctioned for the taluk. Register V enables us to know how much advance is available for the purpose. See the form of register V. It contains 3 major headings the first for the advance portion, the second for the collection portion and the third for the charges to be made against Public Departments.

The advance portion has to account for all the charges incurred on account of the purchase of stones and the advance made to maintenance officers and also to account for amounts realized against this advance. When contractors are paid on account of stones supplied or when advances are made to mintenance officers, the amount is drawn from the Treasury in a Bill in Form A and is entered as a debit under "Revenue Survey Advances—Collectors" in column 3 of Register V.

When stones are sold to ryots for cash and the remittance is received, the amount is entered as a credit under "Revenue Survey Advances—Collectors." Similarly, when a bill in Form III is received the total amount of the bill under cost of stones and 'hired labour' is entered as a credit under "Revenue Survey Advances—Collectors" in column 5, the number of the bill in Form III being quoted in column 4. The collection of the amount of the bill recoverable from private bodies or individuals is, as already explained, watched under a separate head. This is done by entering the amount as a debit under "Cost of Survey marks—Collectors" in column 6. Such portion thereof as is chargeable to Government is debited to "5 (a) L. R. charges of administration (ii) Taluk establishments" in column 9. So far, therefore, as charges debitable to Government are concerned, the entries are closed when the amounts are noted in columns 5 and 9. So far as the debits entered in column 6 are concerned, the collections made thereon are entered in Register V as they are received in the tresury, *i.e.*, in the order of the date of receipt. The collection is also noted in red ink against the original debit entries.

So then, the transactions appearing under debits in Revenue Survey Advances in Register V will be for amounts spent under form A bills out of the advance sanctioned for the taluk. The credits will be cash when stones are sold and book transactions in the case of bills. The collectable amounts out of the book transactions are noted as debits under "Cost of Survey marks—Collectors."

Supposing then that the floating advance sanctioned for a taluk has all been drawn upon for the purpose for which it is intended, at any time, if you deduct the credits in column 5 from the debits in column 3 the balance must show the total value of the stock of stones in the several villages plus the permanent advance with the maintenance officers.

Similarly, in the case of amounts recoverable from private individuals of bodies if the amount in column 7 is deducted from the amount in column 6 the balance is the amount to be recovered.

The V register does not show by villages the total amounts recoverable under all heads. This information is posted in the third administrative register, *viz.*, VI. It is kept by villages and is posted with reference to bills and the demand, collection and balance are exhibited against each bill.

A little consideration will impress you that the total demand under "cost of stones and hired labour" and also the collection under the same head in Register VI must agree with the totals of columns 6 & 7 respectively of the V register. The total arrear according to Register VI under the above head must therefore be the outstanding debit (column 6—col. 7) of Register V.

The accounts are so framed that they enable the survey advance to be recouped without waiting for collection from the ryots. The collections are watched separately under "Survey marks Collectors." The terms demand collection and balance

are therefore applicable only to the latter, *viz.*, "Cost of Survey marks—Collectors." They have no application to "Survey Advances." A demand no doubt arises when stones are actually used. But when this happens the demand is automatically transferred to the head "Cost of Survey marks—Collectors." Under "Survey Advances" there can only be cash receipts and book adjustments. Under "Survey Marks" there are only cash collections against the transferred demand. The outstanding advance amount is always the value of the total stock of stones plus the permanent advance allowed to maintenance officers. The outstanding balance under "Cost of Survey marks—Collectors" is the amount remaining to be collected out of the demand transferred to that head.

You have next got to know how the administrative and treasury accounts are kept. The entries made in the registers with reference to the bills actually received in the taluk office and adjusted should have made this clear.

All amounts paid to stone contractors for stones supplied to village depots should be drawn from the sub-treasury in a bill in form A. The amount of the bill should be entered as a debit under "Revenue Survey Advances—Collectors" in Form V. At the same time the number of stones supplied to each village depot should be entered in Form 1.

The permanent advance given to maintenance officers for payment of hired labour is also to be drawn in Form A and similarly debited.

As soon as a bill in Form III is received from the maintenance officer

(i) the bill is assigned a serial number in the taluk office—the series commencing from 1st April and ending with 31st March; and all the sections of a bill relating to the same village and to the same transaction being assigned one number. The bill is numbered and filed.

(ii) The entries in the bill as regards cost of stone and hired labour are checked.

(iii) The number of stones used as per the bill is noted in Form 1 quoting the taluk number of the bill as the authority for the deduction in the last column (to be authenticated by the Tahsildar or Head Accountant).

The balance of stock is struck and compared with the extract from the village depot sent by the maintenance officer. A note of such verification is made both in the stock register and in the extract.

(iv) The total under "cost of stone and hired labour" should be entered in an adjustment voucher in Form IV, which should be got approved by the Tahsildar and passed through the treasury for adjustment in the treasury accounts. The amount should be entered in column 5 of Register V as a credit under 'Revenue Survey Advance' and as a debit in column 6 under 'Survey Marks-Collectors' (or, in column 9 so far as the portion of charges debitable to Government is concerned) under the date on which the voucher is passed through the treasury (the entries to be authenticated by the Head Accountant). The date of adjustment should be noted on the bill.

(v) The amount of 'Hired labour' is drawn from the treasury in a bill in Form A and debited in column 3 of Register V as a debit under 'Revenue Survey Advances—Collectors'. The amount so drawn is to be paid to the intenance officer to recoup his permanent advance.

(vi) The amounts of the bill under 'Cost of stone and hired labour' should be entered in the Bill Register VI.

Cash Receipts.—(i) The amount of cash received from the village munsiff on account of stones sold to ryots is to be entered in column 5 of Register V as a credit under 'Revenue Survey Advances'.

(ii) The amount collected on account of 'stones and hired labour' is entered in column 7 of Register V as a credit under 'Survey marks—Collectors' against the date of credit. It should also be entered in red ink against the original debit entry. The collection should also be noted in Register VI and on the bill.

Connection between the administrative and treasury accounts and how they are compared and verified. Thus every entry in Register V must be supported by

(i) a cash bill in Form A.

(ii) an adjustment bill in Form IV.

(iii) a chalan for payment of money into the treasury.

Consequently, every entry in Form V must find a corresponding entry in the sub-treasury accounts of receipt and expenditure. On page 20 of the sub-treasury receipt account is maintained a plus and minus memo account under the heads 'Revenue Survey Advance—Collectors' and 'Cost of Survey marks—Collectors'. To detect discrepancies it is only necessary to compare the monthly totals of Register V with the plus and minus memo. To prevent discrepancies arising, the administrative register in Form V may also be compared with the Sub-treasury Day Book at the close of each day.

An extract from Register V and a Demand, Collection and Balance Statement are sent every month by the taluk office. The entries are verified with reference to the Huzur Office plus and minus memo and the returns are reviewed in the general branch.

Also, under the Accountant-General's Circular No. T. M. 1, dated 1-4-1915, the Huzur Treasury communicates the correct plus and minus memo balance as per Treasury every month for the information of the Sub-Treasury Officer.

So far as the stock register (Form 1) is concerned, there is no monthly check. At the end of each half-year (September and March) a half-yearly return (prepared solely with reference to the administrative registers) is submitted and in this the value of the stock *worked out from Form 1* is shown. This plus the permanent advance with the maintenance officer must agree with the net debit balance under Register V and also with the Treasury accounts.

Returns.—The returns to be submitted are :—

(i) Monthly extract from Register V.

(ii) Monthly Demand, Collection and Balance.

(iii) Half yearly return.

For forms of the half-yearly return *see* B. S. O. 34-A, Appendix II.

As stated above, the half-yearly return alone exhibits how far the stock value agrees with the treasury figures. The stock value should be independently worked out from the register in Form 1 and the total value compared with the sub-treasury figure under 'Revenue Survey Advances'. Very often, the difference between this and the permanent advance is put down as the stock value. Such dishonest certificates must be strictly prohibited. If the certificate is truly and honestly furnished, discrepancies come to light which can be investigated and set right. At all inspections of Taluk SurveyAdvance Accounts, the correctness of the half-yearly certificate must be verified.

Profits and losses—meaning—Principles of Adjustment.—What are termed as 'profits' under 'Survey Advances' arise from two causes :—(1) adoption of a rate of selling price higher than that paid to the contractor. These rates are to be uniform for each taluk and in whole annas, the next highest anna when the rate paid to the contractor involves fraction of an anna, and one anna more if it is in exact annas and (2) excess stock found in the depot or unclaimed stones added to stock.

(i) *Uniform rates.*—For correspondence relating to this *see* B. P. 333 R. S., dated 11-11-1914. Uniform rates are necessary (1) to cover inequalities in price and fractions of a pie in the net cost worked out per stone on the basis of the contractor's rates, (2) to simplify the maintenance of the accounts and (3) to cover a reasonable interest on the capital expended in purchasing and stocking stones.

When the contractor is paid at a certain rate, say Rs. 25 per 100 stones, if 1,000 stones are purchased the debit entry in Register V will be Rs. 250. After purchase, the rate of selling price adopted will be annas five per stone. This means that cash receipts and bills will be coming in at the higher rate. The credit will, therefore, be in excess of the debits and if all the 1,000 stones are expended, the credits will amount to Rs. 312-8-0 against the advance of only Rs. 250. The extra Rs. 62-8-0 represents the profits. Strictly speaking, under the system of keeping these accounts as soon as you have realized the value of all the 1,000 stones, your debits and credits must exactly close. This result can be secured only if, as soon as the revised rate is adopted, the debit entry is increased so as to agree with the total value of the stones at the higher rate. The objection to this step would be that no money is actually paid from the Treasury. It is, therefore, necessary to effect a book adjustment. A book adjustment by way of debits cannot, however, be made unless a corresponding credit entry is made. By means of an adjustment voucher, therefore, the amount of profits is shown as a debit under 'Survey Advances' and as a credit to 'Land Revenue.'

Excess Stock—Excess stock generally occurs owing to carelessness or irregularity in the original transactions. At times, contractors commit the mistake of carting more stones than are billed and paid for ; when stones are taken over from the Survey Department some mistakes occur in the number of stones so taken over ; and, occasionally, unclaimed stones are found in fields which are added to the stock in the depot.

When such additions are made to stock, we will in course of time be realising the value of stones for which we have not paid anything. For the reasons given under (1) the debit balance has to be increased by means of an adjustment voucher.

Losses.—What are termed 'losses' occur in two ways, (1) when stones are carted from one depot to another and (2) when the value of damaged or lost stones is written off.

(1) To meet the cost of carriage, money has to be drawn from the Treasury in Form A and debited to 'Survey Advances.' This amount is not going to be recovered and credited. The debit balance would therefore include an amount which is not going to be recovered at all. This portion of the debit must, therefore, be eliminated by means of an adjustment. The only way to adjust, so far as the survey advance is concerned is to show a credit entry for the amount of the cartage. When this is done, a corresponding debit entry must be shown in the accounts under some other head. An adjustment voucher is, therefore, prepared to show the amount of the losses as a credit under Survey Advance and as a debit against Land Revenue.

(2) In the same way when the value of stones accidentally broken, or accidentally destroyed by fire, etc., is written off (the Collector has power to write off up to Rs. 50) in as much as this value is not going to be recovered, the existing debit balance has to be reduced by that amount by means of an adjustment voucher.

In either case—profit or loss—the principle is that no amount should be included under credit which is not also included under debit, and no amount should be included under debit without being eliminated, in the usual course, by way of credit.

The more frequent items will be 'under profits.' The rule is that ordinarily profits should not be adjusted then and there but only from time to time under the orders of the Collector. That is to say, they will be kept unadjusted for some time. This procedure is adopted (1) to avoid the sudden enhancement of the debit amount beyond the sanctioned floating advance and (2) to set off the profits against losses, if any, on account of cartage, etc., that may arise, with a view to finally adjusting the net profit or net loss.

Suppose an advance of Rs. 1,000 is sanctioned and the Tahsildar spends Rs. 750 on the purchase of stones and Rs. 10 as advance to the maintenance officer. He will then have Rs. 240 still to draw upon. Suppose that owing to the adoption of uniform rates, the total value of stones comes to Rs. 950. If the profit of Rs. 200 thus resulting be adjusted then and there the debits under 'Survey Advances'

will be Rs. 950+Rs. 10 or Rs. 960 which means that the Tahsildar has only Rs. 40 more to draw upon. On the other hand, if the ascertained profit of Rs. 200 is simply noted for information and kept unadjusted, the balance of Rs. 240 will still be available. As more credits come in the profits can be adjusted without affecting the floating advance. If, in the meantime, some 'losses' items also occur, the net profit or loss can be adjusted finally.

The existence of unadjusted profit or loss will affect the agreement between the survey advance debit balance and the stock value. In the case of profits the stock value would always be greater than the debit balance under survey advances minus the permanent advance to the maintenance officer by an amount equal to the unadjusted profits.

Similarly, in the case of losses not yet adjusted, the stock value will be less than the debit balance minus the permanent advance by an amount equal to the unadjusted loss.

The adjustment of profits and losses will be clear from a perusal of the entries in Form V in Appendix II to B. S. O. 34-A.

GENERAL HINTS FOR CHECK OF SURVEY ADVANCE ACCOUNTS.

It will facilitate the scrutiny of the accounts if the clerk is instructed to prepare beforehand for the period taken up for check a statement in the following form :—

Bill No.	Date of receipt.	Date of adjustment.	Date of collection.	Arrears—cost of stone and hired labour.

This statement will at a glance give an idea as to the promptness in the adjustment of bills and collection, the amount of the arrear and its duration. To check the accounts cursorily, take up the bills and see (i) if they have been regularly filed, (ii) if they have been serially numbered in the taluk office, the series commencing from 1st April and ending with 31st March, (iii) if all the sections of a bill relating to one village and to the same transaction are given only one number, and (iv) if the dates of adjustment and collection are noted on the bills.

Take up some bills at random, find out the number of stones of each description appearing as removed from the village depot, look up the stock register for the village and see if the stones have been deducted from the stock quoting in the last column the taluk number of the bill as the authority for the transaction.

In the stock register, the balance of stock should have been struck after each such transaction. Look up the extract in Form 1 which the maintenance officer should have submitted along with the bill and see if the balance shown in the extract and that in the taluk register agree. A note of such verification should be made in the extract as well as in the last column of the register if the balances agree ; otherwise, steps should immediately be taken to reconcile the discrepancy, the Village Munsiff being held responsible for the stock in the village depots.

Then look up Register V under date of adjustment noted on the bill and see (i) if the total of the bill under 'cost of stones and hired labour' is noted as a credit in column 5 quoting the taluk number of the bill in column 4, (ii) if the total amount under 'cost of stones and hired labour' is entered as a debit in col. 6, and (iii) if the amount debitable to Government finds place in column 9.

Take up the Bill Register VI and see if the recoverable amounts of the bills are entered in it. If subsequent collections have been shown in the register, verify the entry with reference to the entry in Register V under the particular date. Also, if the whole or any portion of the amount is in arrear, see if the D. C. B. statement accounts for it.

3. Most of the transactions will have been checked in this way. The only other items that will remain to be checked are cash recoveries on stones sold or on account of lost or damaged stones. These credits will appear in column 5 of Register V. Go through the register and see if in respect of such credits necessary deduction has been made in the stock register for the villages concerned.

Finally, compare the net debit balance of some months with the balance shown in the plus and minus memo of the Sub-Treasury account and see how far they agree. Then, taking the stock value of the stones up to a certain date, see if the value plus the permanent advance allowed to the maintenance officers agrees with the balance under Revenue Survey Advances as per Register V up to that date. The difference, if any, which must be due to profits or loss kept unadjusted, must be readily traceable. In any case, check the last half-yearly return and see if the certificate in it has been honestly furnished.

4. Take up the last monthly D. C. B. statement, verify if the total arrear under 'cost of stones and hired labour' agrees with the net debits under 'Cost of Survey Marks—Collectors' according to V register. Find out the duration of the oldest arrear and also if any steps have been taken to recover the arrears.

5. Generally, it must be seen that the transactions in Registers I, V & VI are initialled by the Taluk Sheristadar or Head Accountant, that there is adequate stock in the village depots and that the transactions in Register V are entered in the same manner as the sample entries given in the Board's Standing Order 34-A, Appendix II.

CHAPTER XXVI—DUTIES OF OFFICERS AND STANDING DIFFICULTIES.

The Karnam is the keystone of the fabric of maintenance.—Maintenance of registry, records, maps and stones depends in a large measure on the correct and honest work on the part of the karnam.

Stone maintenance.—He is required to inspect stones and note their condition in the stone registers. Fudged inspection is bound to affect statistics and to retard maintenance. Wrong classification of stones (as requiring renewal or repair) fritters away the time and energies of the maintenance officer and harasses the

ryots. The karnam must know what stones require to be listed for action under the rules. When the maintenance officer finds a stone listed by the karnam intact, ten to one he is tempted to show the stone as attended to and unnecessarily charge the ryot. Honest and correct inspection on the part of the karnam is, therefore, essential. The karnam should further get as many renewals and repairs done by the ryots as possible before the maintenance officer's visit. He is in the best position to get this done ; and if he does so, the co-operation of the ryots is secured to a larger extent, the charge on the ryot is less and the maintenance officer's time can be devoted to more important work.

The karnam should prepare and submit to the Revenue Inspector for signature notices under Section 15 (2) of the Survey and Boundaries Act as required in para. 7 of Appendix II to B. S. O. 34-A.

Current changes.—In the matter of current changes the karnam has to measure and prepare the sub-division record in the first instance. The rule no doubt is that the sanction of a sub-division is subject to the condition that it is check-measured on the ground later on. This provision cannot, however, excuse a manifestly wrong record prepared by the karnam. The order sanctioning the change issues on the authority of the map prepared by the karnam and on the extent noted by him. It is necessary, therefore, that both these should be as accurate as possible. The karnam has also to note what sub-divisions can be clubbed. In the course of sub-division or other work if he notices any error in the records it is his duty to make a report of them to the Tahsildar in order that the necessary corrections might be got made.

Records.—As soon as orders are received sanctioning changes in the specification of survey numbers the karnam should carry out the changes in the village accounts.

Registry.—This portion of the karnam's work is the most important and is at the same time the most neglected. Changes of registry both by decease (10-A) and by enjoyment (App. to B. S. O. 31) should be regularly reported by him. In respect of transfers affecting portions of survey numbers (or sub-divisions) he should not conceal the fact of sub-division being possible in cases of distinct enjoyment.

FIRKA INSPECTOR.

Stone Inspection.—The Firka Revenue Inspector is responsible for the adequacy and genuineness of the stone inspection by the karnam. *Whenever* the Revenue Inspector visits a village he must go through the register, see that the inspection has been sufficient, overcheck the inspection and see that it is genuine. Though the Firka Revenue Inspector is allowed to inspect stones not already inspected by the karnam, his duty is more the overcheck of the karnam's inspection than original inspection. Otherwise, he will be only doing the inspection *for*

the karnam. Special attention must be paid to inspection of stones on the boundaries of Government wastes and porambokes. The Revenue Inspector should also particularly note if the classification of stones as missing or requiring repair is correct. He should renew or repair stones only after satisfying himself that the prescribed notices have been served. He is responsible for the prompt preparation and submission of bills.

The Revenue Inspector is responsible for amending the stone registers when new stones are added *e.g.*, demarcation of poramboke sub-divisions or new fields, or, when stones are eliminated *e.g.*, when an intensively demarcated poramboke field or sub-division is transferred to ayan. He should also suitably alter column 2 of the stone register when new sub-divisions are given effect to. The accuracy of the arrears under stone maintenance as reported by the karnam in the last return should be checked by him. Each Firka Revenue Inspector has to do every month 75 stones under renewal and repair or check measurement of 25 sub-divisions or a combination of both items of work *e.g.*, 10 sub-divisions together with 45 stones.

Current changes.—The Firka Revenue Inspector is responsible for honest and correct check measurement of sub-divisions and incorporation thereof in the village copy of the field measurement book. In cases of acquisition he measures the sub-division himself in the first instance and also demarcates it. He is responsible for entering the changes in the case of sub-divisions in the village accounts quoting the number and date of the order sanctioning the change and authenticating the entries himself.

Transfer of registry.—A Revenue Inspector after making personal enquiry in the village where the land is situated may dispose of such petitions presented to him as do not involve the formation of new sub-divisions or about which there is no dispute. Disputed cases and cases involving sub-divisions should be submitted to the Tahsildar or Deputy Tahsildar as the case may be for orders. Similarly, the Revenue Inspector will not dispose of applications for transfer of registry of unenfranchised inams if they involve sub-division of jodi or quit-rent. He is required under B. S. O. 31, para. 5 (ii) to overhaul all cases of transfer in each village of his firka once in six months.

Depot.—The Revenue Inspector should check the stock in the village depot register and send extracts to the Taluk Office.

The Taluk Tahsildar.

The Taluk Tahsildar keeps the counter part of the records and is responsible for incorporation of changes therein. He keeps a counter part of the stock register of stones and all the accounts relating to the transactions in stones and collection of the charges. He is competent to sanction most of the changes in specification and he exercises a general supervision over the work of the other maintenance officers.

Inspecting Tahsildar.

The duties of this officer are described in B. P. 39 Press, dated 7th August 1925 and in G. O. No. 93 Rev., dated 18-1-1927 communicated with B. P. No. 6, dated 31-1-1927. They are extracted in Appendix III to B. S. O. 34-A. He is responsible for efficient maintenance work in the district and he is expected to get the defects noticed by him rectified then and there as far as possible.

The Divisional Officer sanctions some of the changes in specification and is also generally the Land Acquisition Officer. At periodical inspections of taluk offices and at the time of jamabandi he has opportunity to check in detail the work that is being done.

The Collector especially sanctions certain changes in specification.

Standing difficulties.—First and foremost is the standing inertia of the karnam on to whose broad back so much falls in the last resort. You can afford to be far more merciful towards him in respect of work not done than in respect of work he pretends to have done and has not.

Firka Revenue Inspectors tend to shirk field inspection. As a rule their over-check of stone inspection is perfunctory. Do not spare them if you find that they are fudging their supervision of the karnam. They are again much too fond of recording statements on transfer of registry cases whereas the facts of enjoyment can so often be found by an inspection of the ground.

The Taluk Sheristadar is supposed to supervise the preparation of the accounts but does not usually do so. And the Taluk Tahsildar is at everybody's beck and call.

CHAPTER XXVII—SPECIAL STAFF.

From the year 1906 the system of appointing a special staff in connection with the resurvey or revision survey of any district, was in force.

To understand the necessity for a special staff you should remember the respective functions of the Survey and the Settlement Departments and how they were being attended to prior to 1906. The fundamental principle of our administration as already explained is that each individual holder of land pays land revenue in proportion to the quality of the soil of his holding and to its exact extent. The former *i.e.*, classification is the main subject of the Settlement Department. With the latter the Survey Department is concerned. Each department from the beginning worked independently of the other though the survey was a preliminary to Settlement and a record of Survey was indispensable to Settlement. In the early period of Survey the Survey Department concerned itself with measuring only 'survey fields' the measurement of holdings being left to the Settlement Department. There was a certain divorce of functions in this arrangement, the Survey Department considering as it were, that its only function was to get up a cadastral survey map instead of producing a record for the benefit of the Revenue

administration, showing the holdings also. As a result of the deliberations of the Survey and Settlement Committee of 1887 an attempt was made to concentrate the various processes of both settlement and survey work. But the only change made in 1887 was the transfer of the work of measuring sub-divisions from the Settlement to the Survey Department. This transfer was not enough as it was found by experience that the bulk of the sub-division work still continued to be done by the Settlement Department. This extra work was necessary because the Survey Party measured and plotted only such of the sub-divisions as were shown in the current accounts of the village—the latest adangal; but the adangal did not always agree with the actual occupation on the ground and the survey which was confined to the holdings as recorded in the field register was thus incomplete. The survey officer could make no fresh partition of the fields even though the ryots themselves requested that it should be done. The Settlement Department which followed made a preliminary verification of the holdings and issued rough pattas on the basis of the survey records. This resulted in numerous complaints of inaccuracies and omission of registry and in the employment of a number of classifiers to travel over the ground that the surveyor had visited before and measure up the additional sub-divisions found necessary. Moreover, many 'survey' errors came to light such as inclusion of private lands in poramboke, clubbing of wet and dry fields and the like. A further resurvey of all fields containing sub-divisions had to be made. Work was done twice by different agencies with the resultant expense of time, labour and money. Moreover, the land register prepared at the time of survey had to be rewritten by the Settlement Department when preparing the 'resettlement adangal' or 'the register of occupation'. The headings of these two accounts overlapped, the latter merely adding details regarding classification and assessment and all particulars of new sub-divisions. The two branches of work being so closely connected together, it was considered desirable to place them under a common head so that the survey operations might be conducted in the manner most conducive to the work of assessment.

Such a common head could be neither the Settlement Officer nor the Survey Officer. It was no doubt once proposed that the Survey Officer should also be the Settlement Officer and some Survey Officers were actually given Settlement training. But the idea was vetoed for the reasons that it has never been the business of Survey Officers to occupy themselves with the village registers and accounts or with such matters as remissions, water charges, irrigation source, cultivation and the like and that they had no occasion to study such subjects in the ordinary course of their duty which were entirely the daily concern of the district Revenue Officer. A Settlement Officer also could not be a Survey Officer as well, as, in that case, a scientific department would be left without expert supervision.

In order, therefore, that the survey might be up to date and subserve the Settlement work it was ordered that before the demarcation and measurement of

holdings was taken up by the Survey Department, a special Revenue staff working under the orders of a special Revenue Officer (invariably a Settlement Officer) should make the necessary preliminary enquiries and prepare an up to date field register and also mark the positions of all sub-divisions and new fields to be measured by the Survey Department. On completion of the survey, the field register and field measurement book were sent to the Special Revenue Staff for making such inspection as might be necessary of the survey work before finally passing the field register and allowing it to be used for the correction of the permanent village accounts.

Ordinarily, the duty of bringing the adangals up to date devolves on the existing Revenue establishment but when the existing adangals were found to be out of correspondence with the state of things on the ground and could not readily be brought into harmony with it by the ordinary Revenue establishment, Special Revenue Staffs were employed.

Special Staffs either preceded a resurvey or followed it, or, were followed by only supplemental survey. The exact method of work was always decided on after an examination of the existing survey. It became more or less a rule that resettlements should be preceded by a special staff. Theoretically a resettlement need produce no change in the accounts except in regard to assessments, but in actual practice you find that a lot of miscellaneous work including revision of holdings is done in connection with resettlements. A revision of registry is not essential to a resettlement as the question of the revision of the rates has got to be decided not on changes in holdings but on other facts such as rise in prices, improvements in communications, etc. You could revise the rates on these data and apply the rates so revised to the holdings as appearing in the latest chitta. But resurvey, revision of registry and miscellaneous inspection are generally carried out before a resettlement as a matter of convenience. When we alter the assessment it is only a matter of justice that each ryot should be furnished with a statement showing the amount to be paid by him in future. As it is particulary necessary at the time of resettlement to be able to give the ryots accurate information, it is at this time that is done the periodical overhauling and spring cleaning of the revenue accounts caused by the inability of the Revenue Department or the maintenance staff to keep the accounts up to date. Remember also that rough pattas have to be issued at the time of resettlement and objections heard. There would be no meaning in issuing pattas to persons who have no interest in the land. The revision of the accounts is useful not so much for settlement as for Revenue administration.

Before a Settlement is undertaken, information is usually obtained to show whether the existing survey is accurate enough to serve as the basis of the new accounts to be handed over by the Settlement Officer to the Revenue Department. When it is considered unsatisfactory resurvey is ordered. Also, till some years

ago, when the registry was found to be seriously at fault, a special staff of Deputy Tahsildars and Revenue Inspectors was appointed. This Special Staff was appointed almost always when a resurvey was ordered.

Whether special staff should precede or follow a resurvey depended on how far the existing records, village maps and Field Measurement Books were either a help or a hindrance to the Special Revenue Inspectors to identify survey numbers and sub-divisions that already found place in the accounts. If the state of the records was such that the Special Revenue Inspector would find it extremely difficult to find his way about, the resurvey was first undertaken according to the 'Bhusthithi' and the records were scrutinised later on by the Special Staff. If the survey records were in a fairly good condition and the tract had been under proper maintenance supplemental sub-division work was all that would be needed and the employment of a professional survey party would be unnecessary.

Work of the Special Staff.—Special Staff work consisted of two main divisions:—

(1) revision of the revenue registry of holdings and bringing it up to date.

(2) what is known as miscellaneous accounts inspection.

We might consider how this work was done when the resurvey preceded Special Staff. The method last followed was what was known as the concurrent system of special staff and survey work. Under this system, as soon as the survey of each Khandam was finished, the Survey Department forwarded to the Special Staff (1) a Khandam location sketch showing the boundaries of holdings according to the limits existing on the ground (2) field maps in which the measurements of the holdings as marked in the eyesketch were shown (3) the rough land register giving the number, sub-division, corresponding old No. and sub-division, description of the land and the name of the owner according to the existing accounts and the name of the enjoyer according to enquiry and (4) a rough area list showing the unchecked areas of the S. No. and sub-divisions as found by the field surveyors.

This land register was checked in the Special Staff Office with reference to the Revenue accounts and old maps. Any discrepancies noticed were listed separately and put down for inspection or orders. This was known as the 'Discrepancy Land Register.' Special attention was paid to the scrutiny of the demarcation and survey of porambokes and inams.

When revising the revenue registry the special staff made use of the entry by the survey in the Land Register as to the name of the enjoyer of each holding. The correctness of this entry had to be verified. An enjoyer might be legally in possession and still be a lessee or a mortgagee and not entitled to the patta. The name might be entirely wrong. If the name of the enjoyer was correct but was found to be different from the man registered as the owner in the latest revenue accounts, then the special staff had to examine his title, verify his sale deeds or obtain the written consent of the registered holder or verify long enjoyment

for over the statutory perod or whatever might be necessary. In this way the entries in the Land Register as regards names of present enjoyers were verified and corrected.

Under miscellaneous inspection fall many items. The Special Staff verified the correctness of the demarcation by the Survey Department of the boundaries of all Government property. If they found that Government land classed as poramboke and reserved was not required by Government, they transferred it to assessed waste and rendered it available for assignment to cultivating ryots. Please *see* G. O. 813 Rev., dated 16th May 1910, G. O. 1368, dated 9th May 1911 and G. O. 3034, dated 24th August 1918 for the principles to be observed in distinguishing poramboke from unassessed and for the treatment of grazing grounds at resettlements. The special staff examined the ayacuts of irrigation sources. If any dry lands required to be transferred to wet and *vice versa* they attended to it. If ayacuts under different sources should touch one another, they were checked, and if any change of source was required, it was made. If any tanks were found to exist for whose construction no proper authority was forthcoming the circumstances were investigated and the matter reported for orders. Inam lands were verified to see that the area of land exempt from Government assessment had not increased.

When the revenue on lands has been alienated on condition that they should be used for a specific purpose, it was examined to see whether the purpose was being fulfilled. The correctness of any money rate of assessment imposed by the Revenue Department had to be verified. The Special Staff also examined any discrepancies noticed in the survey records.

The enquiries and inspection necessary for the revision of registry and for the disposal of these miscellaneous items were all done together by the Special Staff.

When the Special Staff inspection was complete, the records were returned to the survey with a list of cases and the necessary sketches in which alterations of the existing boundaries were found necessary.

These supplemental sub-divisions or alterations were attended to and the Survey Department proceeded with the other processes to get the record of measurement out in its more or less final form.

With the return of the survey records the Special Staff were able to correct the land register up to date embodying all changes.

When special staffs preceded the survey, the holdings to be measured were marked by them for the guidance of the survey in an enlarged Khandam sketch, the survey followed it and then the records were finally checked by the Special Staff.

This system of Special Staff work was replaced by what has come to be known as the 'Simplified System' the main departure from the original system consisting in the absence of detailed enquiries about the registry of each and every holding. If the tract is not resurveyed, the registry according to the latest adangal is followed for purposes of rough pattas and changes in registry with corresponding correction of maps, where necessary, are carried out as a result of the objections preferred and disposed of at the time of the objection hearing. Where the tract is resurveyed, the name of the enjoyer as noted by the survey in the land register is adopted for purposes of rough patta and corrected, where necessary, as a result of objections. Under either system, of course, miscellaneous inspections for the purpose of a correct classification of porambokes and other classifications of land, transfers from wet to dry and *vice versa* or from one source to another, etc. are all carried out as explained above before the revision of the rates.

APPENDIX I TRAVERSE COMPUTATION.

Station.	Observed inward angles.	Cor.	Deduced bearing.	Cardinal direction.	Reduced bearing.	Distance measured.	Difference of latitude and departure for each distance.								Difference of latitude & departure of each station referred to the meridian of the first station.		Sum of each successive pair of cordinates Column No. 17.	Area.			
							Latitude.				Departure.				Latitude.	Departure.		Product of Col. 18 with 8 & 9 or 10 and 11.		Offsets.	
							North.		South.		East.		West.		N. or S.	E. or W.		N×E or S×W.	N×W or S×E.		
						Chains	Chains	Cor.	Chains	Cor.	Chains	Cor.	Chains.	Cor.	Chains.	Chains.	Chains.	Acres.	Acres.	Acres.	Acres.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
A	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
B	65°25	..	281°40	N W	78°20	12—38	2—50	..	..	..	..	..	12—12	..	N 2—50	W 12—12	W 12—12	..	3—03	..	1—47
C	223°11	..	167°05	S E	12°55	20—55	..	..	20—03	..	4—59	..	..	..	S 17—53	W 7—53	W 19—65	39—36	..	3—14	..
D	42°14	..	210°16	S W	30°16	23—85	..	..	20—60	..	..	..	12—02	..	S 38—13	W 19—55	W 27—08	55—78	..	..	2—21
E	242°12	1	72°30	N E	72°30	17—40	5—28	..	..	..	16—59	1	..	..	S 32—90	W 2—97	W 22—52	..	11—78	0—52	0—44
F	73°05	..	134°41	S E	45°19	14—49	..	..	10—19	..	10—30	..	..	..	S 43—09	E 7—33	E 4—36	..	4—44	..	1—64
G	119°09	..	27°46	N E	27°46	30—36	26—87	..	..	..	14—14	1	..	..	S 16—22	E 21—46	E 28—79	77—36	..	..	3—61
H	92°31	..	326°55	N W	33°05	24—90	20—86	..	..	..	..	..	13—59	1	N 4—64	E 7—86	E 29—32	61—16	..	1—63	1—46
A	222°14	..	239°26	S W	59°26	9—13	..	..	4—64	..	..	..	7—86	..	0—00	0—00	E 7—86	..	3—65	..	73
..	1080°01	1	..	..	..	..	55—46	..	55—46	..	45—62	2	45—59	1	..	..	..	233—66	22—90	5—29	11—56
																		22—90			5—29
																		210—76	Double area of polygon.		6—27
																		105—38	Area of polygon.		
																		6—27	Area of offsets.		
																		99—11	Area of the whole figure.		

Proof of Angles. 8 × 180—360=1080.

The observed bearing 281°40.

55

APPENDIX II.

నె ౪౬

రోజుగుదస్తా పైమాయిషిచేశ్ని బంట్రోతు వుశేను వుళగిమాన్యం యిరుగులవాణి చేనుకు పశ్చిమం యినాం మెంటీ సంజీవిగాడు కట్టుబడిసర్వమాన్యం వీరారెడ్డి సరకారు యిరుగులవానిచేనుకు వుత్తరం చలపెద్ద ఓబడుసరకారు పెద్దయ్య్ర చేనుకు పూర్వం యిరుగుల వానిచేను స్తళం ౧కి బాకీ వారి౧౹ (.

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జిరాయతి నారల చన్నారెడ్డి

నె ౪౩

యిదకెవుత్తరం సరకారు మైలారివెంకటసామె జిరాయతి తిప్పారెడ్డి సరకారు నడిగడ్డవంక్క చేనుకు పశ్చిమం పల్లె అయప రెడ్డి సరకారునడిగడ్డచేనుకు దక్షిణం పుట్టముగుడు చేను స్తళం ౧కి బాకివారి౨

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APPENDIX III.

Section 5.—The Local Government or subject to the control of the Local Government, any officer or authority to whom this power may be delegated by it may by notification order a survey of any Government land or of any boundary of such land or of the boundary forming the common limit of Government land and land that is not Government land.

Section 6.—(1) When any survey is ordered under Section 5, the Survey Officer shall publish a notification in the prescribed manner inviting all persons having any interest in the land or in the boundaries of which the survey has been ordered, to attend either in person or by agent at a specified place and time and from time to time thereafter when called upon for the purpose of pointing out boundaries and supplying information in connection therewith.

(2) A notification published under Sub-section (1) shall be held to be a valid notice to every person having any interest in the land or in the boundaries of which the survey has been ordered.

Section 8.—The cost, if any, of the labour employed and of the survey marks used in any survey notified under Section 5 shall be determined and apportioned in the prescribed manner among the persons who have any interest in the land or in the boundaries of which the survey has been ordered and shall be recoverable from such persons as an arrear of land revenue. Notice of such determination and apportionment shall be given in the prescribed manner to the persons aforesaid.

Section 9.—(1) The survey officer shall have power to determine and record as undisputed any boundary in respect of which no dispute is brought to his notice.

(2) Notice of every decision of the Survey Officer under Section 9 (1) shall be given in the prescribed manner to the registered holders of the lands the boundaries of which may be affected by the decision.

Section 10.—(1) Where a boundary is disputed, the Survey Officer after making such inquiry as he considers necessary, shall determine the boundary and record it in accordance with his decision. The Survey Officer shall record in writing the reasons for his decision.

(2) Notice of every decision of the Survey Officer under Section 10 (1) shall be given in the prescribed manner to the parties to the dispute and other registered holders of the lands the boundaries of which may be affected by the decision.

Section 11.—(1) Any person affected by a decision under Section 8, 9 or 10 may appeal to the prescribed officer. The decision of the appellate authority with reasons therefor shall be recorded in writing and notice of such decision shall be given in the prescribed manner to the parties to the appeal. Any modification of the Survey Officer's decision, ordered by the appellate authority, shall be noted in the record prepared under Section 9 or 10 as the case may be.

(2) A copy of the order under Section 10 or 11(1) and a copy of the order regarding the boundaries as determined under Section 9, 10 or 11 (1) shall be furnished to any person interested in such orders as the case may be on his application and at his cost.

Section 12.—(*a*) An appeal under Section 11 shall be preferred within three months from the date of service of the notice under Section 8, 9 or 10, provided that the time taken to obtain a copy of the decision and of the map shall not be included in the period of three months allowed for appeal.

(*b*) No appeal preferred after the expiry of the said period shall be admitted, provided that the appellate authority may admit an appeal after the expiry of the said period on his being satisfied that the appellant had good and sufficient cause for not preferring the appeal within such period.

Explanation.—The fact that notice under Section 8, 9 or 10 was not served personally on the appellant shall be deemed to be good and sufficient cause within the meaning of the above proviso.

(*c*) No appeal shall be admitted under Sub-section (*b*) after the issue of the notification specified in Section 13.

Section 13.—When the survey of any land or boundary which has been notified under Section 5 has been completed in accordance with the orders passed under Section 9, 10 or 11, the Survey Officer shall notify the fact in the District Gazette and a copy of such notification shall be posted in the village chavadi, if any, of the village to which the survey relates ; unless the survey so notified is modified by a decree of a civil court under the provisions of Section 14, the record of the survey shall be conclusive proof that the boundaries determined and recorded therein have been correctly determined and recorded.

Section 14.—Any person deeming himself aggrieved by the determination of any boundary under Section 9, 10 or 11 may, subject to the provisions of Parts II and III of the Indian Limitation Act, 1908, institute a suit within three years from the date of the notification under Section 13 to set aside or modify the said determination and the survey shall, if necessary, be altered in accordance with the final decree in the suit and the alteration, if any, shall be noted in the record.

The plaintiff in such suit shall join as parties to it all persons whom he has reason to believe to be interested in the boundary which is the subject of the suit.

Section 15.—(1) Subject to such conditions as may be prescribed in this behalf, every registered holder of Government land shall be bound to maintain, renew and repair the survey marks on or within the boundaries of his holding, and in default of his doing so the survey officer or the Collector may, at the cost of the Local Government, maintain, renew and repair such survey marks, determine and apportion the cost of so doing, and recover such cost as an arrear of land revenue. Such cost may include the cost of all operations incidental to such renewal or repair but not any charges on account of Survey Officers and supervising establishment.

(2) Before a Survey Officer or Collector maintains, renews or repairs any survey marks, he shall serve a notice in writing on the registered holder in the prescribed manner giving the particulars of the survey marks in respect of which default has been committed and calling upon him to maintain, renew or repair the same within a time to be specified in such notice which shall be not less than 15 days from the date of service thereof.

(3) If the notice under Sub-clause (2) cannot be served personally on the registered holder, a copy of the same shall be served also on the cultivator or other person interested in the land.

THE SURVEY OF ESTATES.

Section 17.—The Local Government or subject to the control of the Local Government, any officer or authority to whom this power may be delegated by it, may by notification direct the survey of any estate or portion of an estate or of any boundary therein.

(*a*) on the application in writing of the proprietor of such estate or, in the case of a boundary, of any person interested therein ; or

(*b*) without such application whenever in the opinion of the Local Government such survey is necessary

(i) for the better or more convenient assessment or levy of irrigation cess ;

(ii) for any other reason to be recorded prior to the issue of such notification ;

Provided (1) that any person making an application under Clause (*a*) shall forward with his application a statement in writing signed by him to the effect that he will pay the whole cost of the survey and if required will deposit the amount in a Government treasury before the survey is commenced and (2) that any survey commenced under that clause may be stopped on the withdrawal of his application by the applicant unless the Local Government sees reason to direct the continuance of the survey in virtue of the power conferred on it by Clause (*b*).

Section 21.—When an estate or a portion of an estate or a boundary in an estate has been surveyed in pursuance of a notification issued under Section 17, the Survey Officer shall report the completion of the survey to the District Collector and to the proprietor, and the following consequences shall thereupon ensue :—

(i) Subject to such conditions as may be prescribed in this behalf, every tenant of the land surveyed, and where there is no tenant, the proprietor, shall be bound to maintain, renew and repair the survey marks on or within the boundaries of his holding, and in default of his doing so the Collector may, after giving notice to the tenant or proprietor as the case may be in the manner provided in Sub-sections (2) and (3) of Section 15, at the cost of the Local Government, maintain, renew and repair such survey marks and recover the cost of so doing as an arrear of land revenue. Such cost may include the cost of all operations incidental to such renewal or repair but not any charges on account of survey officers and supervising establishment.

(ii) It shall be the duty of the headman and of the accountant of every village the whole or a part of which has been surveyed

(*a*) to prevent the destruction, injury, removal or alteration of any survey mark on or within the limits of his village ; and

(*b*) when he becomes aware that any such marks has been destroyed, injured, removed or altered, to report the fact to the proprietor of the estate and to the Collector or to such officer subordinate to the Collector as the District Collector may, from time to time, direct.

Form of Section 6 Notification.

In continuation of the notification published at page   of the *District Gazette*, dated   192 , the undersigned hereby notifies, under section 6 of the Madras Survey and Boundaries Act, 1923, that the survey operations of lands in the village of the / town of   Taluk,   District, will commence on   19 .

2. Every person claiming to be interested in such lands as registered holder or otherwise should attend either in person or by agent at the time and place specified and from time to time thereafter when called upon for the purpose of pointing out boundaries and supplying information in connection therewith.

3. The survey operations will be conducted under the immediate charge of the Survey Officer named below and all petitions connected with the survey should be addressed to him.

Name of Survey Officer. } ....

Notice under section 9(2) of the Madras Survey and Boundaries Act, VIII of 1923.

To Village.

The subjoined statement is an extract from the Survey Field Register giving particulars of the lands registered and surveyed in your name. Appeals, if any, against the survey should be presented within three months from the date of service of thi notice to whose headquarters are at

Field maps may be had on application and payment of the prescribed fees which are, except in special cases, six annas per field.

N.B.—No appeal will lie in pursuance of this notice in respect of boundaries decided during the present survey under Section 10(1) of Act VIII of 1923.

Date *Survey Officer.*

Initial survey / Resurvey / Revision survey.		As per revenue accounts of fasli			As now surveyed.	Remarks.
Survey Field Number.	Sub-division Number.	Survey Field Number.	Sub-division Number or letter.	Area.	Area.	
(1)	(2)	(3)	(4)	(5)	(6)	(7)
				Ac. C.	Ac. C.	

NOTICE UNDER SECTION 8 READ WITH SECTION 20 OF THE MADRAS SURVEY AND BOUNDARIES ACT, VIII OF 1923.

To

Village.

The subjoined statement is an extract from the land registers prepared during survey, giving particulars of the lands surveyed in which you are interested and the total charges on account of the stones used and labour employed therefor. Appeals, if any, against the charge should be preferred within three months from the date of service of this notice to whose headquarters are at

PLACE,

Date

58

Survey Field Number.	Sub-divisions.	Total charges.	Remarks.
(1)	(2)	(3)	(4)
		Rs. A. P.	

MADRAS SURVEY NOTIFICATION.

1. Notice is hereby given under Section 13 of the Madras Survey and Boundaries Act of 1923, that the survey of the undermentioned S. Nos. in Village No. (Name) is now complete.

2. Unless the survey hereby notified is modified by a decree of a Civil Court under the provisions of Section 14 of the same Act, the record of the survey shall be conclusive proof that the boundaries determined and recorded therein have been correctly determined and recorded.

CAMP,

Date,

Survey Officer.

U18
N31.1

TAMIL NADU ARCHIVES LIBRARY
ACC. NO. 12761
EGMORE, MADRAS-600 008

Fig. 1

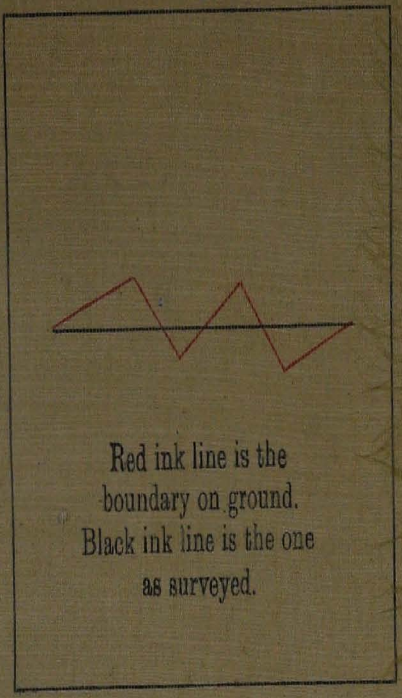

Fig. 2

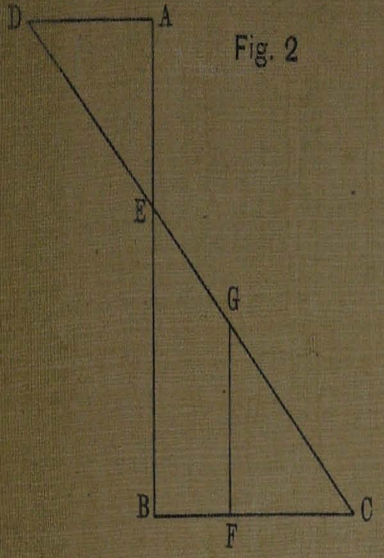

Fig. 4

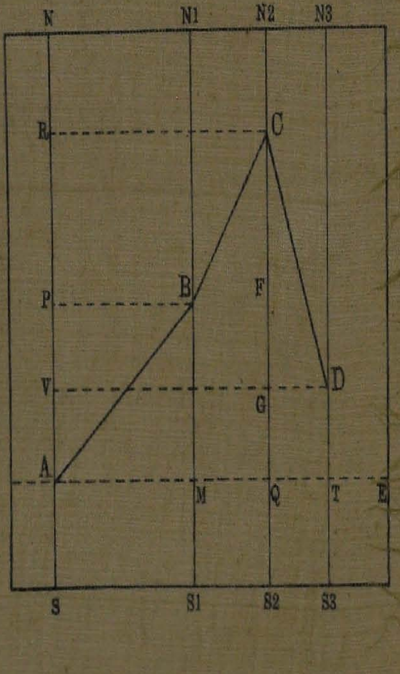
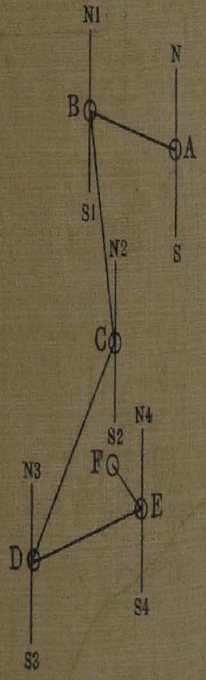
Fig. 6